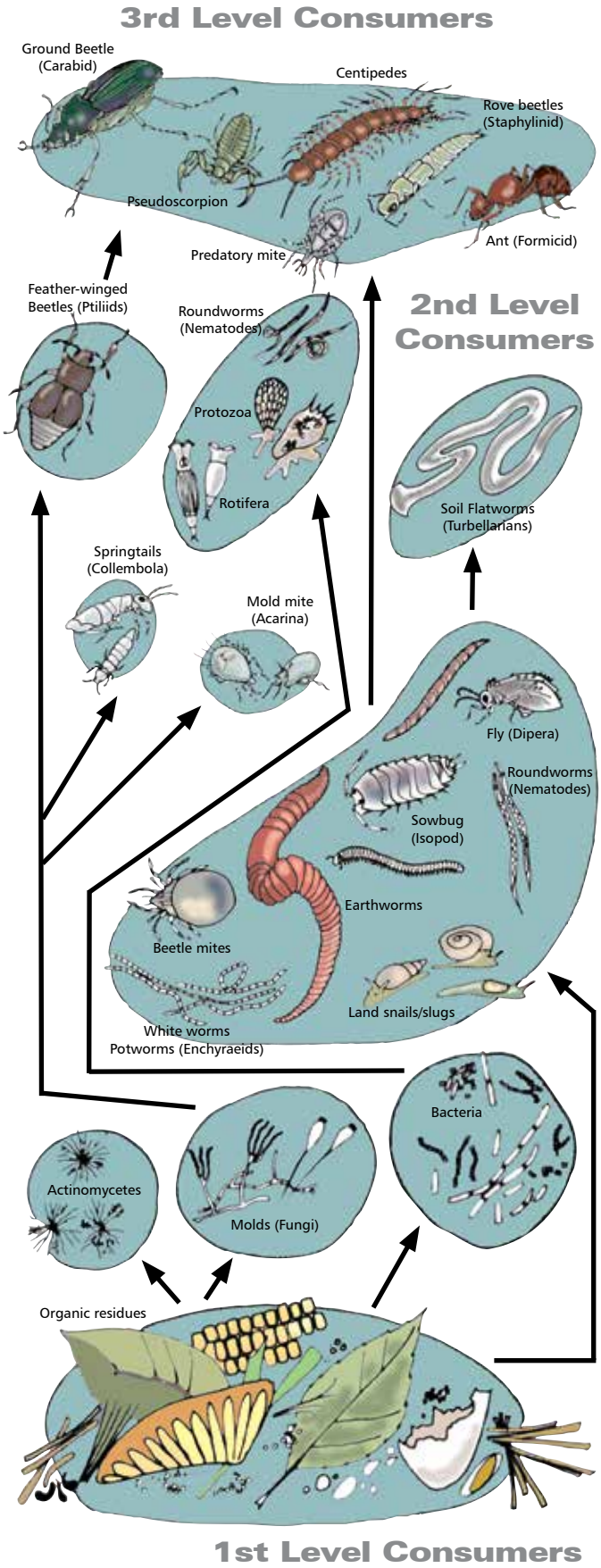
SOUTH CAROLINA

SMART GARDENER

HANDBOOK

Down-to-Earth Tips, Guidance and Information on How to 'Go Green' in Your Backyard

Compost Food Web



Typical Composting Bins

Round Composting Bin

Food Composting Cone Bin

Screen Composting Bin

Worm Composting Bin

Three-way Composting Bin and Cinder Block Composting Bin

SOUTH CAROLINA

HANDBOOK

Down-to-Earth Tips, Guidance and Information on How to 'Go Green' in Your Backyard

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Introduction

The S.C. Smart Gardener Handbook is designed to help you learn the basics of going green in your backyard.

The handbook, which is the centerpiece of the S.C. Smart Gardener Program, covers a variety of topics including healthy soil, composting, natural lawn care and smart watering as well as limiting or eliminating your use of pesticides. Any of these recommendations, if turned into practices by you at home, will help conserve resources, protect South Carolina's environment and maybe even save you money.

Composting at home is the perfect example. Consider the many green benefits. Compost is a valuable product that:

- reduces the amount of waste a household generates;
- improves soil quality;
- increases the ability of soil to hold water;
- insulates plants against extreme temperatures;
- helps plants absorb nutrients; and
- suppresses plant diseases and pests.

These benefits reduce your need to water as often and reduce the need to buy and use fertilizers and pesticides. That lessens potential runoff pollution to nearby streams, rivers and lakes and saves you money.

In short, even the smallest individual actions can have lasting environmental benefits. This handbook provides the information, tips and guidance for you to take those actions to go green at home.

The S.C. Department of Health and Environmental Control's Office of Solid Waste Reduction and Recycling (Office) produces this handbook in partnership with Clemson Extension and the S.C. Department of Natural Resources.

This handbook is adapted from "The Natural Lawn and Garden: Healthy Landscapes for a Healthy Environment" series developed by the City of Seattle's Saving Water Partnership. For more information, visit **http://gardenhotline.org**. All text and material are used with permission. Photographs are provided by Ian Edelstein and Richard Hartlag unless otherwise noted. All illustrations are by Wilda Boyd.

In addition to this handbook, the S.C. Smart Gardener Program also includes workshops and technical assistance as well as other printed materials. For more information on the S.C. Smart Gardener Program, visit **www.scdhec.gov/compost** or call the Office at **1-800-768-7348**.

Thank You ...

Special thanks to the steering committee that helped develop this handbook.

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Foreword

By Bob Polomski

Horticulturist/Extension Associate, School of Agricultural, Forest and Environmental Sciences, Clemson University

Gardening is the most popular hobby in America and rightfully so. It offers the benefits of beauty, nourishment and exercise. Also, gardening establishes connections with friends and neighbors in the community and serves as a bridge between generations of young and not-so-young gardeners. I still have fond childhood memories of my grandfather sharing stories with me while we worked side-by-side in the garden.

Whether you have a garden or a landscape at home or in the community, strive to become a knowledgeable and responsible gardener. Watering, fertilizing and controlling pests affect the health and appearance of the plants in your garden and landscape. These activities, however, also have an impact on the environment. Therefore, gardeners have the responsibility of safeguarding our land and water resources.

The S.C. Smart Gardener Handbook contains information and techniques that will improve your gardening skills and help you protect and preserve our environment. A few of the practices that are discussed in the handbook include:

- building healthy, fertile soil with organic matter and selecting and using appropriate fertilizers. Soil is the foundation of the garden and landscape. Improving its fertility and selecting the right fertilizers will keep the plants healthy and protect water quality;
- reducing waste by recycling yard trimmings and food scraps back into the garden and landscape. This sustainable practice "feeds" your plants and improves the soil;
- conserving water by watering efficiently at the right time and with the right amount;
- managing pests – weeds, insects, and diseases – by learning how to avoid them and how to deal with pests when they appear. This section will introduce you to non-chemical approaches, such as managing insects by handpicking, trapping or using barriers, before resorting to less toxic pesticides. When pesticides are absolutely necessary, applying them properly will avoid harming beneficial insects and animals as well as contaminating soil, surface water and groundwater; and
- selecting the right plants for the right location in South Carolina landscapes. Growing adapted, pest-resistant plants will make gardening less about controlling pests and more about growing and enjoying plants.

At the end of most chapters you will find a list of books, organizations, Web sites and other helpful resources.

The S.C. Smart Gardener Handbook will inform and inspire you. It will fuel your desire to grow vegetables, flowers, shrubs and trees. The handbook may even encourage you to teach your friends and neighbors about composting, fertilizing, watering wisely and managing pests responsibly. Enjoy your adventure as you learn how to protect our natural resources as you create and maintain nourishing gardens and beautiful landscapes.

Contact Information ...

Readers are encouraged to contact their local Clemson Extension office for more information throughout this handbook. A list of county offices and telephone numbers is available at **www.clemson.edu/extension**, then click on COUNTY OFFICES on the left menu. Readers may call Clemson Extension's Home and Garden Information Center at **1-888-656-9988**.

For more information about the S.C. Smart Gardener Program and other recycling programs, call DHEC's Office of Solid Waste Reduction and Recycling at **1-800-768-7348** or visit **www.scdhec.gov/compost**.

Part One:

Start with healthy soil.

Adding compost and other organics improves your soil.

Did you know that by simply improving your soil, you can beautify your lawn, garden and flower beds, cut your water bill, improve water quality in our streams, reduce your work outdoors and improve the value of your home? Healthy soil is the key. Anyone can improve the quality of their soil. It is as easy as adding compost and other organic amendments to your soil.

Compost is the dark, earthy material naturally produced by decaying plants and animal waste. This mix of living and dead organic matter supports an intricate web of soil life, which in turn keeps your soil loose, moisture-holding, fertile and well-drained.

Here are three simple steps for improving the quality of your soil.

- Before planting, amend the soil throughout the entire planting area with compost.
- Mulch existing plantings with compost, leaves, grass clippings, pine bark or wood chips.
- When you need to feed plants, use natural organic and slow-release fertilizers.

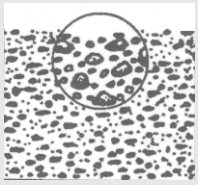
Understand your soil.

Soil is the mineral portion that supports plants, supplies nutrients and stores water.

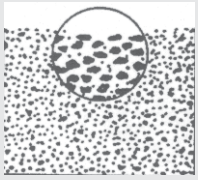
Air and water are essential elements that transport nutrients to plants and carry away waste. They make up half the volume of healthy soil. Compacted or heavy clay soils may not have adequate space for air and water to move freely to plant roots.

Organic matter and soil life (e.g., earthworms, beetles, bacteria, microorganisms) make up just a small part of the soil volume, but are the glue that holds healthy soil together. Decomposing plant materials, like compost, support a great variety of beneficial organisms.

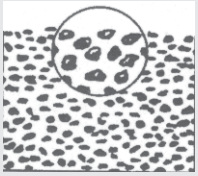
There are three general types of soil determined by the size of the soil particles. This affects how the soil functions. You may have more than one kind of soil in different areas of your garden.



Sand



Clay



Loam

Sandy soils contain large particles that are visible to the naked eye. They feel gritty and will not form a ball when squeezed in your hand. Sandy soils are loose and drain easily, but do not store water or nutrients for plants.

Clay soils are made of tiny particles that feel sticky when wet and dry into dense chunks or fine powder. They hold nutrients and water well, but drain poorly.

Loamy soils are a mix of sand, clay and organic matter. When squeezed in your hand, moist loam forms a ball which crumbles when poked with a finger. Loamy soils are generally loose, well-drained and able to store moisture and nutrients. Organic matter and soil life keep plants healthy by:

- supplying balanced nutrients to growing plants;
- fighting plant diseases and pests;
- storing fertilizers and natural nutrients for gradual release, while preventing them from washing into water bodies;
- storing water, which reduces runoff and your garden's irrigation needs;
- making clay soils better drained and easier to work; and
- trapping and breaking down pesticide residues and polluted runoff.

Protect your soil's health.

Excessive use of chemicals, overwatering and soil compaction can harm beneficial soil organisms and reduce their ability to keep soil healthy.

- Think twice before using pesticides that may damage soil life.
- Don't overfertilize. More is not better.
- Avoid overwatering. Too much moisture can promote plant disease and exclude air from roots.
- Prevent soil compaction by walking on garden beds as little as possible, keeping heavy equipment and cars off lawns as well as minimizing the use of rototillers.

Enrich your soil before planting.

The best way to improve the soil is to add plenty of compost or other organic matter throughout the entire planting area before planting. Thoroughly mixing these materials deep into the soil helps provide water, air and nutrients to plant roots.

WHEN? Mix in organic material before:

- planting lawns, perennials, trees and shrubs;
- replanting annual beds;
- dividing perennials; and
- repotting container plants.

HOW? Use a shovel or digging fork to mix amendments into the top 6 to 12 inches of soil. *It is important to amend the entire planting bed – not just small holes for each plant.* When planting individual trees and shrubs in lawns or existing beds, amend an area at least 3 feet wide, or at least four to five times as wide as root balls more than 12 inches in diameter. Rototill large areas where digging is impractical.

WHAT? Different types of organic amendments may provide special benefits for certain plants or soil types, as the chart below describes. But any clean composted or aged organic amendment will improve the soil. The best advice is to use what is reasonably priced, plentiful and readily available.

How do I know good compost?

Poor quality compost can introduce weeds to a planting bed and make nutrients unavailable to plants while it finishes decomposing. Signs of good compost are:

- sweet, earthy smell;
- dark brown or black color;
- fibrous texture (like peat); and
- no weed sprouts, mushrooms or other growths.

How much compost?
(Mix into 100 SQUARE FEET of planting area.)

LAWNS: Mix compost down to 6-inch depth.
Clay soils: 8 cubic feet (.3 cubic yard) = 1-inch layer of compost
Sandy soils: 13 cubic feet (.5 cubic yard) = 1.5-inch layer of compost
GARDENS & LANDSCAPES: Mix compost to 10- to 12-inch depth.
Clay soils: 16 cubic feet (.6 cubic yard) = 2-inch layer of compost for new gardens. Use 1 inch per year in established gardens.
Sandy soils: 24 cubic feet (.9 cubic yard) = 3-inch layer of compost for new gardens. Use 1-2 inches per year in established gardens.

Which soil amendment to use?

AMENDMENT CHOICE	PROS AND CONS
Best All-Purpose Materials	
Compost made from yard trimmings, food scraps or barnyard manure	Recycled and readily available. Balanced nutrients. Yard trimmings can be composted at home. Properly composted materials are free of weeds, pests and diseases.
Leaves (composted or fresh)	Free. Rich in nutrients. Usually contain a few weed seeds.
Other Materials	
Bark or sawdust	Improves drainage in clay soils. Good for trees and shrubs. Fresh materials must be composted until dark brown in color or they can tie up nutrients and inhibit plant growth.
Peat moss	Improves moisture and nutrient storage in sandy soils, but does not support soil life.
Coconut coir	Improves moisture and nutrient storage in sandy soils, but does not support soil life. Renewable product from coconut palms.
Topsoil mixes	Good for raised beds on top of compacted or poorly drained soil. May contain poor fill soil or weeds. Best to use mixes containing only compost and clean sand.
Expanded aggregate	Lightweight. Can be designed to meet project specifications. Can improve properties and qualities of existing soils. Not as strong as conventional rock.

Mulch your plantings.

Mulch refers to a material placed on the soil surface. Although usually organic, mulches also can be products such as gravel, tire mulch and landscape fabric. Mulches reduce evaporation, limit weed growth and limit soil erosion that can choke streams and fish. Most mulch products provide these benefits, but organic mulches – such as compost or bark – can be especially beneficial because earthworms and other soil life gradually break them down, mixing them into the soil to nourish plants.

WHEN?

- Apply annually or as needed.
- Mulch in early summer to conserve moisture, feed plants and prevent weed seeds from sprouting.
- Mulch in fall to protect soil from erosion, smother weeds and retain warmth.

WHERE?

- Mulch annual and perennial planting beds as well as the surface of container plantings.
- Cover entire tree and shrub planting beds or make mulch rings at least three feet wide around each plant in lawns.
- Mulch should be at least 6 inches from the trunks of trees and shrubs and should not be in contact with stems of annuals and perennials.

HOW?

- Remove weeds and grass before spreading mulches.
- Use porous weed barriers such as woven landscape fabric or cardboard to smother aggressive perennial weeds before mulching.

HOW MUCH?

- Grass clippings: 1/2 to 1 inch deep.
- Compost, leaves, sawdust or medium- or fine-ground bark: 1 to 2 inches deep.
- Coarsely shredded bark, wood chips or tree trimmings: 2 to 3 inches deep.

NOTE: One cubic foot of mulch covers 12 square feet 1 inch deep. One cubic yard will cover 324 square feet 1 inch deep or 108 square feet 3 inches deep.

Fertilize moderately and responsibly.

- **Fertilize moderately with natural organic and slow-release fertilizers to grow healthy, easy-to-maintain plants.** Too much fertilizer can produce excess growth that is easily damaged by pests, wind, frost and drought. Many of the nutrients in quick-release fertilizers may wash off to pollute lakes, streams and groundwater.

Which mulch to use?

MULCH CHOICE	PROS AND CONS
ANNUALS, PERENNIALS, BERRIES AND ROSES Annuals and perennials benefit from mulches like compost, aged manure or grass clippings which feed plants quickly and can be mixed into the soil without tying up nutrients.	
Composted yard debris, bark, barnyard manure or biosolids	Neat appearance. Important to use aged manure or quality compost that is free of weed seeds.
Leaves and grass clippings	Free and readily available. May spread weed seeds or disease. For a finer texture, leaves can be composted or run over with a lawn mower before being applied. May be considered unattractive.
OTHER SHRUBS AND TREES The best mulches for shrubs and trees are coarse, woody materials that protect the soil for a year or longer, slowly releasing nutrients for steady plant growth.	
Fresh bark	Tidy appearance and readily available. May inhibit growth of some plants.
Sawdust/wood shavings	Usually free. Best if aged. Cannot be from chemically treated lumber.
Wood chip/shredded prunings	Natural look. Free and readily available. May spread weed seeds or disease.
Newspapers layered under other mulch materials	Decompose to feed soil. Aggressive weeds may grow through.
Woven fabric weed barrier	Long lasting, but does not break down to feed soil. May get tangled in weeding hoes. Aggressive weeds may grow through fabric over time.

- **Most established trees and shrubs do not need regular fertilization.** Mulching can provide all their nutrient needs in most cases. Even heavy feeders – like roses, annuals and flowering perennials – take in adequate nutrients through yearly mulch applications.
- **When choosing a fertilizer**, look for the words **natural organic** or **slow-release** on the fertilizer bag. Though these fertilizers may cost more, they offer better value and greater protection of water quality as more of their nutrients actually feed plants instead of washing into streams or groundwater.
- **Natural organic fertilizers** include rock phosphate and other minerals, plant products such as alfalfa meal and animal by-products like bone or fish meal. Most nutrients in natural fertilizers must be digested by bacteria before they dissolve in water and plants can use them. These nutrients are slowly released when warm soil stimulates the bacteria, which is when they are needed by actively growing plants.
- **Slow-release fertilizers** such as sulfur-coated urea become available as outer coatings are dissolved by moisture and activated by soil bacteria when plants are actively growing.
- **Quick-release fertilizers** like urea and ammonium sulfate quickly dissolve in water. They wash through the soil with rain or irrigation if not immediately used by plants or absorbed by organic matter.

Basic Fertilizing Schedule

LAWN GRASS	POUNDS OF NITROGEN PER 1,000 SQ. FEET PER YEAR*	WHEN TO APPLY
Bahia grass	1/2	May, July
Bermuda grass	1 to 2	May, June, July, August
Centipede grass	1 to 2	May**, July
St. Augustine grass	2 to 4	May, June, July, August
Zoysia grass	1 to 2	April, July, August
Fescue, Bluegrass	1 to 2	February, September, November

* Split into at least two or three applications
** Use a fertilizer based on soil test results. Fertilize centipede grass using a low phosphorus, high potassium fertilizer.

Keep the following tips in mind when fertilizing.

- Amend the soil in the entire planting area instead of making individual holes for plants. As in a forest soil, organic matter should be concentrated near the surface.
- Mulch the entire area, keeping mulch away from the base of trees and shrubs.
- Fertilize established trees and shrubs only if they are stunted or show signs of need.

Reality Check

Fertilizing should ideally be based on observed plant needs or soil tests. If you would like to have your soil tested, call Clemson University's Agricultural Service Laboratory at **(864) 656-2068**. Detailed information also is available at **www.clemson.edu/agsrvlb**.

By the Numbers ...

Soil tests recommend actual pounds of nutrients to apply, yet fertilizer labels list nutrient contents by percentages. The three numbers prominently displayed on fertilizer packages are the percentages of nitrogen, phosphorous and potassium. To figure out how many pounds of fertilizer are needed to get 1 pound of a nutrient, divide 100 by the percentage of the nutrient contained in the fertilizer. See the example below.

RECOMMENDATION: Apply 1 pound of nitrogen per 1,000 square feet.

FERTILIZER NUTRIENT CONTENT: 5:3:2 = 5 percent nitrogen, 3 percent phosphorous and 2 percent potassium. Calculate: 100/5 = 20 pounds of fertilizer per 1,000 square feet to supply 1 pound of nitrogen.

If you use soluble fertilizers, you can reduce nutrient runoff by applying half the suggested amount twice as often as recommended. Avoid using any fertilizer near bodies of water to prevent pollution.

Test your soil.

There are several nutrients that are essential for plant growth. A soil test is used to determine the amount of these nutrients in your soil. The resulting report also will tell you the pH value – how acidic or basic your soil is – and it will make a recommendation for the amount and type of fertilizer and/or lime you need to add. This allows you to customize your soil fertilizer and lime applications to your plants' needs.

How to Take Soil Samples ...

- To have a soil analysis done, collect soil from 12 or more places in your yard that will be combined as one composite sample. A garden trowel or shovel can be used to collect the samples. The samples should include soil from the surface to a depth of 6 inches in all areas of gardens/landscaping or 2 to 3 inches in lawns.

- Follow the sampling procedure above for each area of your yard or garden to be tested. Testing results may be very different for lawns and garden areas. You may want one sample in your turf area, one in any foundation or perennial bed and one in your vegetable garden.

- Place the samples in a clean plastic bucket and mix them thoroughly. Use clean sampling tools because pesticide or fertilizer residues will create misleading results. The sample must not be excessively wet before it goes to the lab. It should be crumbly and break apart easily.

- If you have a problem area where plants do not seem to grow well, take a separate soil sample from that location.

- Bring a minimum of 2 cups of soil per sample to your Clemson Extension office.

- Be sure to keep track of where the sample was taken in your yard. The Clemson Extension office will ask you to provide the information on a soil test box, fill out a record sheet and check the appropriate boxes for the analyses desired.

- The cost of a standard soil test is less than $10 for each sample. This test provides scientific information on the soil pH value, the current soil levels of phosphorus, potassium, calcium, magnesium, zinc and manganese as well as fertilizer and lime recommendations, if needed.

Clemson Extension recommends soil testing each year. Soil samples can be taken at any time, but it is best to sample the soil a couple of months before planting or fertilizing.

Soil Test Results ...

Within seven to 14 days, your soil analysis will be mailed to you from the Agricultural Service Laboratory. Your Clemson Extension office also will receive a copy. Your soil analysis will include bar graph showing the amount of soil nutrients found and the soil pH value.

The primary nutrients for healthy plant growth are nitrogen (N), phosphorus (P) and potassium (K). Secondary nutrients calcium (Ca), magnesium (Mg) and sulfur (S) are required in less quantity, but also are essential for good plant growth. Zinc and manganese are micronutrients required in very small amounts, easily corrected by keeping the soil at the optimum pH value.

The report will show how much lime (if needed) to add for each 1,000 square feet. The comments page will tell you what type of fertilizer you need, how much you need and how to apply it. These recommendations are specific to whatever type of plant you want to grow (as indicated on the soil test record sheet).

Questions?

Please contact your Clemson Extension office. For a county-by-county list of contacts, visit **www.clemson.edu/extension** and click on COUNTY OFFICES.

Credits

This section was adapted from information provided by Marjan Kluepfel, Home and Garden Information Center, Information Specialist and Dr. Bob Lippert, Extension Soil Fertility Specialist, Clemson University.

Part Two:

Composting at Home

A Guide to Managing Organic Yard Trimmings*

Garden and yard trimmings (e.g, leaves, grass clippings) account for up to 20 percent of the waste disposed of in landfills. Obviously, it makes sense to divert these materials to mulch or compost. Through these processes organic trimmings can be recycled to improve and beautify the garden and landscape.

Composting is a biological process in which microorganisms convert organic materials (such as leaves, grass, manure and food scraps) into an end product called compost – a dark, crumbly, earthy-smelling form of organic matter that reveals no hint of its origin. Composting is the same process that decays leaves and other organic remains in nature, except that composting controls the conditions so that the materials decompose faster.

Composting can occur under either aerobic (in the presence of oxygen) or anaerobic (without oxygen) conditions. Microorganisms involved in aerobic composting require oxygen. The amount of oxygen in the compost pile must be greater than 5 percent. (By comparison, fresh air is about 21 percent oxygen.) Anaerobic microorganisms prefer an absence of oxygen. Aerobic decomposition is the preferred composting technique because it is the most rapid and efficient.

When mixed with soil, compost increases the organic matter content, improves the physical properties of the soil and supplies essential nutrients, enhancing the soil's ability to support plant growth. The practice of applying materials such as compost, leaves or grass clippings to the soil surface is called mulching. Mulching conserves moisture, controls weeds, reduces erosion, improves appearance and keeps the soil from gaining or losing heat too rapidly.

* From the "S.C. Master Gardening Training Manual" prepared by Robert Polomski, Extension Associate, Consumer Horticulture Coordinator, Department of Horticulture, Clemson University

Composting Organisms

Most composting organisms fall into two general groups – microorganisms and invertebrates. Among the microorganisms, aerobic bacteria are the most important in terms of beginning the decomposition process and generating heat.

The organisms present in a compost pile can be separated into three types. First-level consumers attract and become food for second-level consumers. Third-level consumers (e.g., centipedes, rove beetles, ground beetles, ants) prey on second-level consumers. *See the "Compost Food Web" on the front inside cover.*

Bacteria are one-celled colorless organisms that cannot make their own food through photosynthesis.

They reproduce by splitting, producing billions of offspring over a relatively short time, although the life span of any particular generation may only be 20 to 30 minutes long. As a group, they can eat almost any type of organic matter, although specific bacterial populations will differ from pile to pile depending on the makeup of the pile and the decomposition stage.

Psychrophilic bacteria are active when a pile is first made, especially in the fall when the weather is cool. Optimum activity occurs at about 55˚F, but these bacteria are still active at 0˚F. The bacterial activity creates heat and sets the stage for the most efficient decomposers, the mesophilic bacteria, which are most active when the temperature of the pile is between 70˚F and 100˚F. As the temperature increases, thermophilic bacteria take over from 113˚F to 155˚F.

Actinomycetes and **fungi**, similar to bacteria, give the compost pile its faintly earthy odor. At the end of the composting process, they may appear as a blue-gray to a light green, powdery or cobweb-like layer in the outer 4 to 6 inches of compost. Fungi generally intermingle with the actinomycetes.

When the inner pile starts to heat up, most invertebrates are killed or migrate to cooler areas of the pile. In the cooler areas, nematodes prey upon bacteria, protozoa and fungal spores. Larger mites and springtails also feed on fungi. The life cycle within the pile continues to become more complex as predaceous mites and pseudoscorpions feed on other mites as well as nematodes. Complex invertebrates, like centipedes and ground beetles, feed on lower life forms, and decaying plant life in the pile attracts sowbugs, snails, slugs and earthworms.

Earthworms

If bacteria are the champion microscopic decomposers, then the heavyweight champion is doubtlessly the earthworm. Ever since it became known that the earthworm spends most of its time tilling and enriching the soil, pages of praise have been written on this creature. The great English naturalist Charles Darwin was the first to suggest that all the fertile areas of this planet have at least once passed through the bodies of earthworms.

The earthworm consists mainly of an alimentary canal which ingests, decomposes and deposits casts continually during the earthworm's active periods. Compared to soil, fresh casts are markedly higher

The Compost Process

Composting is the biological decomposition of organic matter. While decomposition occurs naturally, it can be accelerated and improved by human involvement. To produce a high-quality end product, it is important to understand the composting process. The microorganisms and invertebrates that decompose yard trimmings and food scraps require oxygen and water.

The heat produced by bacterial activity increases the temperature in the compost pile to as high as 160˚F. As the process nears completion (after one month to one year), the pile temperature once again approaches the surrounding air temperature.

Nitrogen contained in yard trimmings and food scraps are necessary for the microorganisms to carry out decomposition efficiently. The conversion of carbon in waste to carbon dioxide results in a reduction in both the weight and the volume of the pile.

Finished compost is composed of microorganisms and invertebrates, their skeletons and decomposition products and organic matter that is not broken down by these organisms.

in bacteria, organic material, available nitrogen and phosphorus as well as calcium, magnesium and potassium.

Earthworms thrive on compost and contribute to its quality through both physical and chemical processes. They reproduce readily in a well-managed pile. Since earthworms can play such a large part in composting, smart gardeners adjust their composting methods to take full advantage of the earthworm's special talents.

Food Web of the Compost Pile

Some of the visible creatures in the compost pile feed directly on organic wastes. Others wait until microorganisms have begun the process. *See the "Compost Food Web" on the front inside cover.*

Factors Affecting the Composting Process

All natural organic material eventually decomposes. The length of the breakdown process, however, can be accelerated through composting, or rather, the efficient "farming of microorganisms." Any factor that slows or halts the growth of these microbes also impedes the composting process. The following factors affect the length of the composting process:

- organic materials (carbon and nitrogen contents of the food source);
- volume;
- aeration;
- moisture;
- particle size; and
- temperatures reached during composting.

Organic Materials

All organic materials contain carbon and nitrogen. One of the most critical factors in composting is the balance of carbon and nitrogen within the plant waste added to the pile. The carbon to nitrogen ratio is commonly expressed as "C:N" or "C/N." Microorganisms require carbon for energy and nitrogen to make protein. Leaves, straw and sawdust are high in carbon while grass clippings, manure, coffee grounds and vegetable scraps are higher in nitrogen. It helps to think of these materials as "browns" and "greens," or better yet, as "dry" or "fresh" to remember which is which. These C:N ratios are significant because microbial activity is greatest when the C:N ratio is 30:1. The tiny composters need about one part nitrogen for every 30 parts carbon.

Average Carbon-to-Nitrogen (C:N) Ratios for Organic Materials

GREENS/ NITROGEN	C:N RATIO	BROWNS/ CARBON	C:N RATIO
Pig manure	5-7:1	Leaves	30-80:1
Poultry manure (fresh)	10:1	Cornstalks	60:1
Alfalfa or sweet clover hay	12:1	Straw	40-100:1
Vegetable scraps	12-20:1	Bark	100-130:1
Poultry manure with litter	13-18:1	Paper	150-200:1
Coffee grounds	20:1	Sawdust	400:1
Grass clippings	12-25:1	Wood chips	800:1
Cow manure	20:1		
Horse manure	25:1		
Horse manure with litter	30-60:1		

SOURCE: Clemson Extension Master Gardener Program

Remember, this ratio describes the chemical composition of a material and does not mean you need 30 times the volume of brown to green.

Pretend you are filling your compost bin. You have leaves (60:1), food scraps (15:1) and grass clippings (17:1). Add the three numbers on the carbon side of the ratio (60, 15, 17) and divide by the number of materials (i.e., three) 92 ÷ 3 = about 31:1. Some people think of it as two parts green to one part brown. Many people have success with equal parts green and brown.

The dominant organic waste in most backyard compost piles is leaves. Grass clippings may compact and restrict air flow. Branches and twigs greater than 1/4 inch in diameter should be put through a shredder/chipper first. Spent plants and trimmings from vegetable gardens and flower beds are excellent sources of nitrogen for the compost pile and may be added with small amounts of soil. Food scraps (e.g., vegetable peelings, coffee grounds, eggshells) are appropriate additions to the compost pile. Other organic materials used to add nutrients to the pile are blood meal, bone meal and livestock manure.

Volume

A pile should be large enough to hold heat and small enough to admit air to its center. As a rule of thumb, the minimum dimensions of a pile should be 3 X 3 X 3 feet (1 cubic yard) to hold heat.

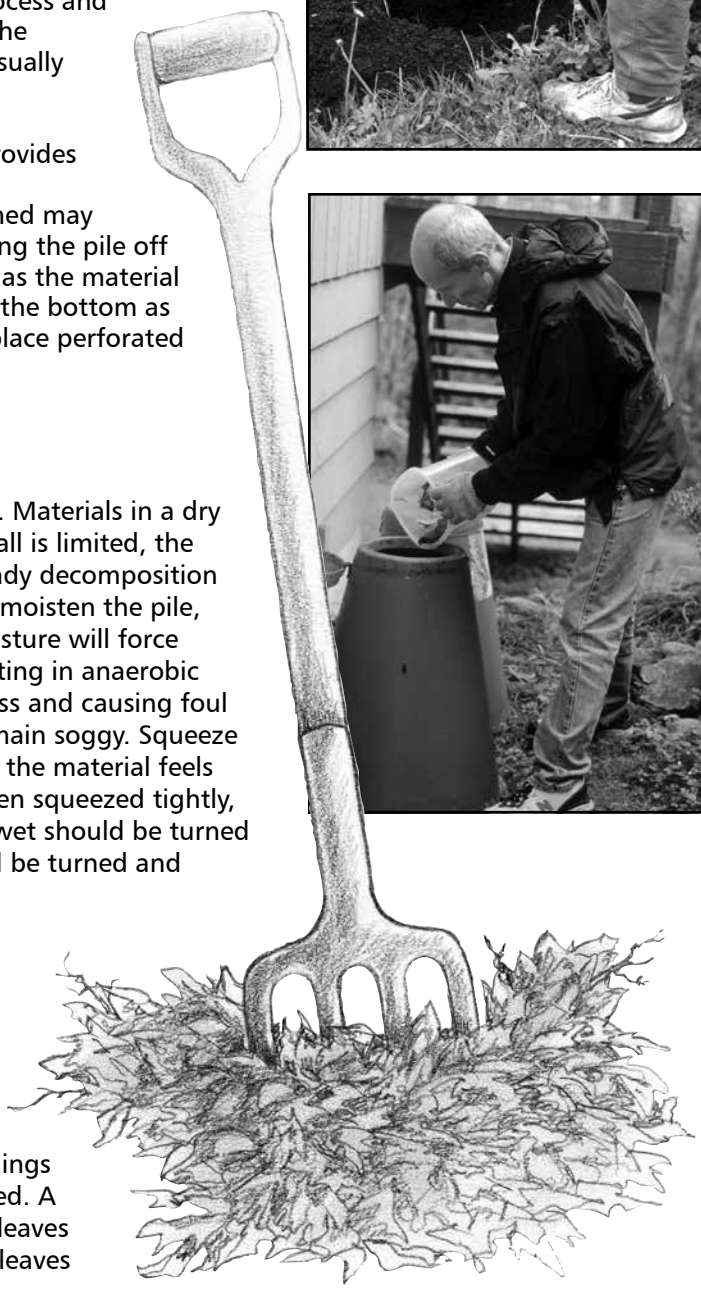
Aeration

Oxygen is required for microbes to decompose organic waste efficiently. Some decomposition can occur in the absence of oxygen (anaerobic conditions); however, the process is slow and foul odors may develop. Also, anaerobic decomposition leads to the production of chemical compounds that are toxic to plants. Organic matter allowed to decompose anaerobically should be exposed to air for several days or sometimes months to complete the composting process and to destroy any plant-toxic compounds. Because of the odor problem, composting without oxygen is not usually recommended in a residential setting.

Mixing or turning the pile once or twice a month provides the necessary oxygen and significantly hastens the composting process. A pile that is not mixed or turned may take three to four times longer to decompose. Raising the pile off the ground allows air to be drawn through the pile as the material decomposes. Coarse materials should be placed on the bottom as the pile is built. Another way to introduce air is to place perforated PVC pipes within the pile.

Moisture

Adequate moisture is essential for microbial activity. Materials in a dry compost pile will not decompose efficiently. If rainfall is limited, the pile must be watered periodically to maintain a steady decomposition rate. Enough water should be added to completely moisten the pile, but overwatering should be avoided. Too much moisture will force out the air and suffocate the microorganisms, resulting in anaerobic conditions, slowing down the decomposition process and causing foul odors. Water the pile so it is damp but does not remain soggy. Squeeze compost in your hand to judge moisture content. If the material feels like a damp sponge and yields only a few drops when squeezed tightly, its moisture content is sufficient. Piles that are too wet should be turned to increase air content; piles that are too dry should be turned and sprinkled with a hose.



Particle Size

The more surface area the microorganisms have to work, the faster the materials will decompose. Grinding the organic material before composting greatly reduces decomposition time. A shredder is useful for chipping or shredding most yard trimmings and is essential if brush or sticks are to be composted. A low-cost method of reducing the size of fallen tree leaves is to mow the lawn before raking. Windrowing the leaves

into long narrow piles 1 foot high will make the shredding process more efficient. If the mower has an appropriate bag attachment, the shredded leaves can be collected directly. A few twigs and sticks can be left in the pile for aeration.

Temperature

The temperature of the compost pile is very important to the biological activity taking place. Heat generated by microorganisms as they break down organic materials increases compost pile temperatures. The microbes that are so essential to the decomposition process fall into two categories: mesophilic, those that live and function in temperatures of 70˚F to 100˚F, and thermophilic, those that thrive at temperatures from 113˚F to 155˚F. While high temperatures have the advantage of killing disease organisms and weed seeds, moderate temperatures encourage the growth of mesophilic bacteria, the most effective decomposers. Pile temperatures between 90˚F and 140˚F indicate rapid composting. Temperatures greater than 140˚F kill or reduce the activity of many of the most active, beneficial organisms. If temperatures exceed 140˚F, the pile should be turned to cool it. If the pile does not reach at least 120˚F, more nitrogen or water may be needed.

Building a Compost Pile

The compost pile should be located near the place where the compost will be used. Composting is best done in a location screened from your view and that of neighbors.

Good locations for the pile are near the garden or between the garage and house. Do not locate the compost pile near a well or on a slope that drains to surface water, such as a stream or a pond. Locating the pile too close to trees also may create problems, as roots may grow into the bottom of the pile, making turning and handling the compost difficult.

The pile will do best where it is protected from drying winds and is in partial sunlight to help provide heat. The more the pile is exposed to wind and sun, the more water it will need.

There are no set rules when building a compost pile. Pay attention to the items covered in the "Factors Affecting the Composting Process" on page 11 and use good judgement and common sense. The following two recipes should help you create a "fast" or "slow" compost pile.

'Fast' Compost Recipe

Fast compost is labor intensive and requires a lot of turning. Maintaining a 30:1 carbon to nitrogen ratio is very important in fast composting. This method can produce compost in a couple of months or less.

The ingredients and tools needed include:

- greens, fresh material (nitrogen);
- browns, dry material (carbon);
- water;
- garden soil (optional);
- a pitchfork;
- a tarp or cover (optional); and
- a hotbed thermometer (optional).

'Fast' Compost Recipe: Step-by-Step

1. **COLLECT MATERIAL** to create a 1-cubic-yard pile (3 X 3 X 3 feet). Chop or shred any coarse materials to increase their surface area. Start the pile with a 4 to 6 inch layer of "browns" (dry), high-carbon materials (high C:N ratio). Next, add a 4- to 6-inch layer of "greens" (fresh), high-nitrogen materials (low C:N ratio). Add additional nitrogen if necessary. Vegetative food scraps should be added in this layer. If food scraps are included, an additional thin layer of soil, sawdust, leaves, straw or compost should be added to absorb odors.

2. **LAYER MATERIAL** until the pile is about 3 to 4 feet high. Remember to water each layer as you construct the pile. Apply about a quarter-inch layer of soil or finished compost between layers. One reason for adding soil is to ensure that the pile is inoculated with decomposing microbes. The use of soil in a compost pile is optional. In most cases, organic yard trimmings such as grass clippings or leaves contain enough microorganisms on the surface to cause decomposition. Studies have shown that there is no advantage in purchasing a compost starter or inoculum. The microbes already in the soil and on organic materials are just as efficient in decomposing the waste as those provided by the commercial inoculum. One way to ensure that activator microbes are present in the new compost is to mix in some old compost as the pile is prepared.

3. **MIX IT UP.** Use your pitchfork to turn the materials added to the pile. When you're done, make the top of the pile slant to the center to catch rainfall. At times, you may want to cover the pile with a plastic covering or tarp to regulate the amount of moisture entering the pile. The cover should not rest on the pile because it may cut off oxygen.

4. **CONSIDER THE POROSITY OF THE MIXTURE.** If dense materials, such as manure or wet leaves are used, wood chips, straw or dry bulky material should be added to improve porosity. The thickness of the layers will depend on the C:N ratio of the materials being used. Mix the layers.

5. **CONDUCT A SQUEEZE TEST** to evaluate the moisture content of the compost. Add water until squeezing a handful will yield one or two drops of water. Adding too much water may leach out nutrients.

'Slow' Compost Recipe

Slow composting takes the least labor and time of the many ways to compost. It's ideal for people who don't have a large amount of yard trimmings to compost all at once. This method can take from six months to two years or longer to produce compost, so be patient.

Stacking cinder blocks on three sides (as pictured on page 13) makes an inexpensive bin. A standard-sized garbage can with eight or more slots in the sides

Troubleshooting Tips for Composting Yard Trimmings

SYMPTOMS	CAUSE	SOLUTIONS
The pile smells like rotten eggs or garbage.	The pile is too wet. There is not enough air.	Turn pile and add dry stalks, leaves or straw.
The pile is dry inside.	There is not enough water in the pile.	Turn and moisten materials, then cover pile.
	There is too much woody material in the pile.	Mix in fresh greens or nitrogen fertilizer such as urea, blood meal or chicken manure. Chop or remove coarse woody materials.
	The pile is too small.	Add material to fill bin or make 3 X 3 X 3 feet pile.
The pile is damp inside, but not composting.	The pile lacks "greens."	Mix in fresh greens or nitrogen fertilizer. Chop or remove excess woody material.
The pile is smaller, but materials are not decomposing.	The outside of pile is dry, but inside has probably composted.	Use material that has not decomposed in a new batch.
The pile has clumps of slimy grass and an ammonia smell.	The pile has too much fresh grass.	Leave grass clippings on lawn or mix in brown leaves or straw.

of the can for ventilation and five in the bottom for drainage also can be used. In all cases, elevate the bin 1 foot off the ground or start the pile with a 3- to 6-inch layer of small twigs or chopped corn stalks to improve air movement and drainage. If you choose not to use a container, cover the heap with a layer of yard trimmings or soil to prevent moisture loss.

The ingredients and tools needed are the same as those for "fast" compost. Add greens and browns to the pile whenever they become available. Turn the pile occasionally to mix the materials together to prevent them from clumping together and to avoid anaerobic decomposition. You will know that materials are decaying without oxygen by the foul odor: a tell-tale sign that it is time to turn the pile. Look for ready-to-use compost near the bottom of the pile.

Curing

Curing is an important and often neglected stage of composting during which the compost matures at low, mesophilic temperatures. Curing finishes the decomposition of resistant compounds, organic acids, large particles and clumps of material that remain after active composting. As a result, the pH shifts toward neutral, the C:N ratio decreases and the concentration of humus increases. When the compost pile's temperature no longer reheats after turning, the curing stage begins. Curing may be considered complete when the pile temperature falls close to air temperature (without the pile being anaerobic or overly dry).

Unfinished compost can be toxic, especially to seedlings and newly established plants. Therefore, compost must be allowed to decompose thoroughly before use.

Composting Alternatives

- **SHEET COMPOSTING** in the garden involves applying raw composting materials directly on top of the soil in layers. Shredded organic matter can be applied between plants as a type of mulch and allowed to decompose slowly. Material can then be incorporated directly into the soil after frost in the fall.
- **TRENCH COMPOSTING** involves digging a trench about 8 to 12 inches deep and filling it up with shredded organic materials. Vegetable and other food scraps (excluding meat, bones and fatty foods) and yard trimmings (especially diseased or insect-infested plants) can be used. Microorganisms and earthworms will slowly convert these materials to usable organic matter. Covered trenches are often used as paths between rows of vegetables while the organic matter is decomposing.
- **COMPOST HOLE DIGGING** is similar to trench composting, except that it involves smaller areas. A post-hole digger can be used to make holes between vegetables or ornamental shrubs and trees. Fill the holes with food scraps and cover them with soil. By the following spring, the organic matter should be decomposed.
- **VERMICOMPOSTING** is the production of compost using worms to digest organic waste.

Using Compost

- **SOIL AMENDMENT:** Compost is used as an organic amendment to improve physical, chemical and biological properties of soil. Adding compost will increase the moisture-holding capacity of sandy soils, thereby reducing drought damage to plants. When added to heavy clay soils, compost improves drainage and aeration and reduces waterlogging damage to plants. Compost increases the ability of the soil to hold and release essential nutrients. The activity of earthworms and soil microorganisms beneficial to plant growth is promoted with compost. Other benefits of adding compost include improved seedling emergence and water infiltration because of a reduction in soil crusting. Over time, yearly additions of compost create a desirable soil structure, making the soil much easier to work. For improving a soil's physical properties, incorporate 1 to 2 inches of well-decomposed compost into the top 6 to 8 inches of soil. Use less for sandy soils and more for clay soils.

  To a limited extent, compost is a source of nutrients. Nutrients are slowly released from compost and, often, the nutrient content is too low to supply all the nutrients necessary for plant growth. It is usually necessary to supplement compost with some fertilizer, particularly nitrogen. If the C:N ratio of the compost is less than 20 to 1, nitrogen tends to be released rather than tied up. For the majority of yard trimmings composts, the C:N ratio is less than 20 to 1. Thus, while compost may not supply significant amounts of nitrogen, especially in the short run, nitrogen tie-up should not be a major concern with most yard trimmings. About 1 cup of ammonium nitrate (0.15 pound actual nitrogen) per 3 bushels (100 pounds) compost is required to provide the additional nitrogen needed by most garden plants.

  Have your soil tested annually to determine whether supplemental phosphorus and potassium are required. The pH of most composts made from yard trimmings is usually 7.0. The neutral pH of compost should not pose any problems when mixed into the soil and, in fact, is beneficial to plants growing in acidic soils.

- **POTTING SOIL:** Compost can be used as a component of potting mixes. Generally, no more than one quarter to one third by volume of the potting mix should be compost. Too much compost may result in waterlogging and poor aeration for roots.

  Although proper composting destroys most weed seeds and disease-causing organisms, some may still survive because of incomplete mixing. To obtain a completely pasteurized compost for use in the potting mixture, heat the material in an oven at 160˚F for 30 minutes.

- **MULCH:** A 2- to 3-inch layer of compost can be used as a mulch around vegetables and ornamental plants. Extend the mulch layer up to or beyond the drip line of shrubs and trees. The drip line is defined by the outer edge of the plant's branches. Applying compost will help conserve moisture and keep the soil cool in the summer and warm in the winter.

Compost Questions and Answers

Q. What is compost?

A. Compost is the partially decomposed remains of plants. In its final state of decomposition, it is referred to as humus.

Q. Does compost have any value as a fertilizer?

A. Yes. Decomposed materials have some nitrogen, phosphorous and potassium content, though in small amounts. The addition of garden fertilizers to speed decomposition supplies some of the nutrients as well.

Q. Can compost be used as a substitute for fertilizer in the garden?

A. It can be used as a source of nutrients; however, there are not enough nutrients present in compost to supply the needs of vegetable crops. The lack of large amounts of nutrients in compost is far outweighed by the other advantages of the organic material.

Q. Is it necessary to add lime (calcium) to the compost pile?

A. No. Too much lime may cause a loss of nitrogen from the pile. Most finished compost will have a nearly neutral pH.

Q. Is it necessary to add inoculum to the compost pile to activate the composting process?

A. No. Inoculation with prepared microbes may hasten the process, but there are enough microbes present in the material being composted to initiate the process.

Q. Should compost piles be covered?

A. A compost pile that has a good moisture content (like a damp, wrung-out sponge) will benefit from being covered with plastic or carpet scraps. Covering helps to keep piles moist in summer and prevents them from getting too soggy in winter. If a pile is too dry or soggy to start, covering may make the problem worse.

Q. What are the best materials for composting?

A. Most plant material can be used for composting. Leaves are perhaps the best material because of their availability and organic content; however, other types of organic materials, such as animal manure (no dog or cat feces), grass clippings, vegetable scraps, small tree limbs and shrubbery trimmings, coffee grounds and rotted sawdust are considered good composting materials. Invasive weeds (e.g., Florida betony, nutsedge) should be left on pavement to thoroughly dry out before composting. Avoid composting feces, meat and dairy products or materials contaminated with chemicals.

Q. How do you know when you have the best carbon to nitrogen ratio (C:N) for fast composting?

A. Experimentation is the best way to get a good sense of carbon and nitrogen ratios in different materials. Composting books often have tables giving some rough figures. See the chart on page 11 for carbon-to-nitrogen ratios for organic materials.

Q. Is it necessary to shred materials for the compost pile?

A. The finer the material that goes into the compost pile, the quicker and more thorough the decomposition.

Q. Do compost piles need turning?

A. Yes and no. Turning the pile will supply more oxygen for the microbe population and will shift undecomposed material on the edge of the pile to the center where it too will be decomposed. Compost can be created without turning, though it will take longer.

Q. How do you gauge the proper moisture content for composting?

A. Materials should feel like a wrung-out sponge, moist but when squeezed in your hand no more than a drop or two of water should come out. Some very dry materials (straw, cardboard and others) may need prolonged soaking to reach adequate moisture levels.

Q. Do compost piles have offensive odors?

A. In general, compost does not produce offensive odors if composted in a bin with adequate ventilation. If animal manure is used, some odor may be detected in the first or second day, but will dissipate as the process accelerates.

Q. What can be done about a smelly pile?

A. Smelly piles are most often caused by poor aeration. The bacteria which live in such "anaerobic" piles produce a rotten egg smell. Smelly piles should be turned to introduce air and encourage "aerobic" bacteria. Wet, compacted areas should be broken up with a pitch fork and coarse, dry materials – such as straw or corn stalks – may be mixed in to aid drainage, absorb moisture and create air spaces.

Q. When is compost ready to use?

A. When the pile returns to normal temperature and the organic material crumbles easily, compost is ready to use. At this point you should not be able to recognize the material that you put in the original pile. The composting process in the average pile takes about 6 to 8 months, though an ideally mixed and tended pile may take less than 8 weeks to become compost.

Q. How can I use compost?

A. Compost can be used to enrich the garden, to improve the soil around trees and shrubs, to amend the soil for house plants and seed-starting mixes (when screened) or to top-dress lawns.

Q. What is the difference between compost and mulch?

A. Compost is decomposed organic material. Mulches are materials – organic or inorganic – used as a surface treatment on soil to suppress weeds, hold moisture and prevent erosion. Compost is just one of many mulch materials. Other mulches include gravel, wood chips, plastic, fabrics and sawdust.

Q. How can wood/bark chips be made to compost faster?

A. Rechipping to open more surface area and adding nitrogen will both speed up decomposition of wood chips to some extent.

Q. Why can't dairy products, meat and fish scraps be composted?

A. Animal products attract flies, rodents and other pests which carry diseases.

Q. Do compost "tumblers" work?

A. Compost tumblers work very efficiently if wastes are chopped, moistened and contain adequate nitrogen. Tumblers with flat sides or internal bafflers are recommended since they mix and aerate materials more thoroughly than those with smooth sides.

Composting Food Scraps

- Burying food scraps in the garden is a simple method requiring no special tools.
- Food "digesters" provide a convenient and pest-resistant way to compost food scraps.
- Worm bins are a fun and interesting method for composting food scraps to produce rich compost and worms for fishing.

Materials to Avoid in a Compost Pile ...

Some materials may pose a health hazard or create a nuisance and, therefore, should not be used to make compost. Human or pet feces should not be used because they can transmit diseases. Although animal remains can be safely decomposed in commercial composters, wastes such as meat, bones, grease, peanut butter, whole eggs and dairy products should be avoided in home compost piles because they may attract rodents.

What CAN be composted at home?

- **GREENS (FRESH MATERIAL):** Fruit and vegetable scraps, bread and grains, coffee grounds and filters, tea bags and trimmings from yard
- **BROWNS (DRY MATERIAL):** Non-recyclable paper, paperboard, fall leaves, clean sawdust and wood shavings

What CANNOT be composted at home?

- **MEAT, FISH, POULTRY OR DAIRY PRODUCTS:** Put them in your household garbage.
- **EVERGREEN LEAVES, SAWDUST OR SHAVINGS FROM PAINTED OR TREATED WOOD AND COATED PAPER**

How to Store Food Scraps in the Kitchen ...

A plastic container with a lid is great for storing food scraps in the kitchen until you are ready to take them outside. Empty the container into your worm bin, a hole in the garden or compost bin every two days so food scraps don't start to smell.

A 5-gallon bucket with tight lid can be used outside to store food scraps for longer periods if it is inconvenient to add them to the compost, but odors and flies may become a problem – especially in summer.

Sprinkling an inch or two of sawdust, peat or coconut coir on top of layers helps prevent flies and odors. Food scraps also can be stored in a plastic container in the freezer to control these problems. Do what works best for you.

Worm Bin Composting (or Vermicomposting)

Worm bins are a fascinating way to turn food scraps into high-quality compost. Follow these easy steps to start your own worm bin. Read Mary Appelhof's book, "Worms Eat My Garbage," for more detailed information on composting with worms.

- **STEP 1: GET A BIN.** Use a sturdy wood or plastic box with a tight-fitting lid to keep out pests and retain moisture. Holes drilled in the bottom are essential for drainage. A box about 1 foot deep is best, since worms must live near the surface to breathe. Worm bins can be made from old cupboards, crates or plywood. Bins made from recycled plastic are available through mail-order catalogs or your local discount store. Worm bins should have 1 square foot of surface for each pound of food scraps added per week. A 2 X 4 X 1 feet deep worm box can process about 8 pounds of food scraps a week – usually enough for two people. Weigh your food scraps for a few weeks before buying or building a bin. Keep worm bins in a basement or enclosed garage if possible. Cold winter weather and hot summer temperatures can dramatically slow worm composting. If the bin is kept outside, find a spot that is shady in summer but gets some winter sun. Outdoor bins can be insulated with rigid foam insulation tacked to the lid and sides.
- **STEP 2: FILL THE BIN WITH BEDDING.** Carbon-rich bedding supplies worms with a balanced diet and helps prevent flies and odors. Good beddings include moist autumn leaves, shredded cardboard or newspaper, straw or untreated coarse sawdust and wood shavings. A mix of these works best. Immerse dry bedding in a garbage can full of water for several minutes

Worm Bin Troubleshooting

SYMPTOMS	CAUSE	SOLUTIONS
The bin smells like rotten eggs or garbage.	The pile is too wet.	Mix in dry leaves, peat moss or sawdust.
	Meat, fish, dairy products or pet waste has been added to the bin.	Keep these items out of the bin.
	Food scraps have not been covered.	Cover food with bedding when added.
The bedding is dry and has few worms.	There is not enough water in the pile.	Mix and moisten the bedding. Cover with plastic or cardboard. Move the bin out of sunlight.
Food scraps are accumulating.	There is too much food in the bin.	Limit the amount of food scraps added. Add more worms. Build another bin.
	The bin is too hot or too cold.	Move the bin to a cool basement or garage. Keep the bin filled with bedding.
Maggots are in the bin.	Meat, fish, dairy products or pet waste has been added to the bin.	Keep these items out of the bin. Cover bedding with cardboard or plastic.
Fruit flies swarm out when the bin is opened.	Food scraps are exposed.	Always cover food scraps with bedding. If you still have fruit flies, add an inch of sawdust or peat moss to the top of the bedding or cover it with cardboard.
Worms are crawling up the sides of the bin.	There is too much food in the bin, the bedding is too wet or the contents are fully decomposed.	Limit the amount of food scraps added. Build another bin or add dry bedding.

before adding to worm bin or mix and spray with hose until everything is moist like a wrung-out sponge. Fill the bin to the top with loose bedding to keep the worms from freezing in winter or getting too hot in summer. (TIP: Save a few bags of leaves each fall to rebed your bin later.)

- **STEP 3: ADD WORMS.** Red worms – also known as "red wrigglers" or "manure worms" – are best for composting. "Earthworms" or "night crawlers" are not suitable for composting. Start with about 1 pound of worms (about 1 pint of pure worms) to keep up with food scraps. Get worms from a friend's bin or visit **www.wormfarmingsecrets.com** for sources.
- **STEP 4: BURY FOOD SCRAPS.** Pull aside bedding to make holes or trenches large enough to lay food scraps 1 to 2 inches thick and deep enough to cover scraps with a few inches of bedding. Bury in a different spot each week to give the worms a balanced diet of food scraps and bedding. Place a sheet of plastic or moist newspaper on top of the bedding to keep moisture in and flies out.
- **STEP 5: HARVEST COMPOST AND WORMS.** After 6 to 12 months, most of the bedding should look like dark, rich soil. To harvest compost and rebed the bin, push the compost to one side (it shrinks as it composts) and fill the empty side with fresh bedding. Then bury food scraps only in the new bedding until any food scraps in the old bedding finish decomposing and most worms have migrated to the fresh food. Harvest finished compost and replace with fresh bedding. It is simple to pick out a few worms for fishing. To harvest more worms to start bins, shovel a few gallons of compost into a pile in bright sunlight. After 15 minutes, scrape away the outer layer of compost until the worms are visible. Repeat until the worms are concentrated at the bottom of the pile.

Stackable Worm Bins

A number of worm bins are for sale that use stacking trays to take advantage of the worms' tendency to feed on the surface and migrate out of finished compost. The top tray is fed fresh food scraps. When material in the bottom level is decomposed and worms move up into fresh materials, the tray is removed, harvested and then rebedded and replaced on top.

Summary: Successful Composting

It's not a secret. Simply place garden scraps in a pile and bacteria, bugs and fungi will turn it into compost, but it may take a year or longer. For quicker composting, provide the decomposer organisms with proper food and conditions.

1. **A BALANCED DIET:** Composting bacteria thrive on a mix of succulent "greens" like fruit and vegetable scraps, annual weeds and flowers, and on woodier "browns," such as autumn leaves and corn stalks. An equal mix of greens and browns works well. Too many greens can produce a smelly, soggy mess. A pile that is mostly browns

To Compost or Not to Compost?

DO COMPOST IN PILES OR BINS	DO NOT COMPOST AT HOME
GREENS (FRESH MATERIAL)	
Fruit and vegetable scraps, coffee grounds, eggshells, etc.	Clippings recently treated with "Weed & Feed" or other herbicide – put in curbside yard waste collection.
Fresh garden trimmings, flowers and plant leaves	Insect-infested or diseased plants – put in curbside yard waste collection.
Barnyard manure (horse, cow, chicken)	Pet feces (dog, cat, rodent, exotic bird)
Garden vegetable leaves and stalks, fallen fruit	Meat, fish, poultry, dairy products – put in disposal or household garbage.
Weed leaves, stems and flowers	Weed seed heads and roots of spreading weeds like ivy, buttercup, morning glory and quackgrass – put in curbside yard waste collection.
House plants and potting mix	Bones, fats or oils
BROWNS (DRY MATERIAL)	
Autumn leaves	Large amounts of evergreen leaves, needles or cones
Twigs and stalks	Branches over 1/2 inch in diameter; berry brambles, rose stems, holly
Coarse sawdust or shavings	Sawdust from plywood, treated or painted wood
Shredded paper, cardboard, paper towels	Coated photo or copy paper, colored paper, waxed cardboard

takes a long time to decompose. The chart on the previous page lists common greens and browns.

2. **BITE-SIZED PIECES:** Decomposers can break down small pieces more quickly than large ones. For rapid composting, chop woody stalks with a shovel or machete, run over them with a lawn mower or put them through a shredder.

3. **MOISTURE:** Materials should be moist but not dripping wet – like a wrung-out sponge. Spray and mix dry trimmings as they are added to the pile. Keep compost piles in the shade and cover open piles with plastic.

4. **FRESH AIR:** If materials are too wet or compacted, composting will slow down and may create bad odors. Start with a good mix of materials, including some coarse stalks or sticks so air can flow through. Let air into soggy piles by turning them and mixing in coarse stalks or dry straw.

5. **PILE SIZE:** A pile that is 1 cubic yard (3 X 3 X 3 feet) is ideal. Smaller piles dry out quickly, though bins with solid sides and a lid help keep small piles moist. Larger piles may need to be turned to let air into the middle.

6. **PREVENTING PESTS AND OTHER PROBLEMS:** Avoid materials that may attract pests, create odors or cause other problems. See the chart on page 20.

Books and Resources

There is a small library of books devoted to composting. In addition, most garden books have a section on composting. Here is a selected list of books you may find helpful. Check with your public library.

- **"Backyard Composting: Your Complete Guide to Recycling Yard Clippings"** (no author listed) – It covers the basics and includes a brief discussion of permaculture and other interesting agricultural ideas.

- **"Compost Critters"** by Bianca Lavies – A wonderful children's book built around the author's spectacular photos that provide a fascinating look at the critters who live in your compost heap. Also shows the author's working compost pile at various stages. It is recommended, especially for children and teachers.

- **"Consumer Reports Magazine"** reviews low-pesticide gardening, shredders and mulching mowers as well as other topics related to composting.

- **"Home Composting Made Easy"** by C. Forrest McDowell and Tricia Clark-McDowell – In South Carolina, call **1-800-768-7348** for a FREE copy. This booklet covers the basics for starting and maintaining a backyard composting bin. It includes helpful tips, plus the DOs and DON'Ts for proper bin maintenance.

- **"Let It Rot! The Gardener's Guide to Composting"** by Stu Campbell – A classic covering all the basics and written in a highly readable style. It includes good discussion of how to not be obsessed with high temperatures (>140˚F) in the home pile and the uses of compost.

- **"Organic Gardening Magazine"** is an extremely valuable and respected resource offering extensive information of landscaping, composting and organic living. For more information, visit **www.organicgardening.com**.

- **"The Rodale Guide to Composting"** by Jerry Minnich and Marjorie Hunt – A "Composter's Bible" of over 380 pages, this book looks at various aspects of composting. The chapter on methods gives the pros and cons of several different ways to make compost.

- **"The Urban/Suburban Composter: The Complete Guide to Backyard, Balcony and Apartment Composting"** by Mark Cullen and Lorraine Johnson – A pleasant book that, in spite of its title, covers the basics much like the other books. It contains a helpful chart comparing different systems for people in different living situations, a few ideas for very small-scale composting and a section on vermiculture.

- **"Worms Eat My Garbage"** by Mary Appelhof – A delightful book with illustrations, which will help you with vermiculturing and vermicomposting. Many experts consider this a classic.

Part Three:

Smart Watering

Smart watering is as easy as 1, 2, 3.

Smart watering means more than just lower water bills. It means healthier gardens. Watering too much or not enough produces weak plants that are susceptible to pests and disease. Learn to give plants the right amount of water for healthy growth and to apply it so every drop counts.

Did you know that many landscapes require very little watering after plants are well established? This only takes one to three years with good soil preparation and proper plant selection, so it pays to do the groundwork.

That's not all. Smart watering promotes a healthier environment for all of us. By helping to keep plants healthier, smart watering practices may decrease the need for pesticide use. Smart watering also may lessen fertilizer and pesticide runoff from landscapes into streams and lakes, where it can affect birds, fish and their food sources. Finally, smart watering conserves water so it can benefit people, plants, fish and other wildlife.

Stock Photography

From May through September, water use in our region nearly doubles, primarily for lawns and gardens. Experts estimate that 50 percent or more of this water goes to waste, due to evaporation, runoff or simply overwatering.

1. Where your water goes depends on how your garden grows.

Plant selection, soil preparation and your watering system's performance all play a role in determining how much water your garden needs and how easy it is to water efficiently.

- **Build better soil with compost and mulch.** Good soil absorbs water easily, drains well and retains moisture. Mix compost into the soil when planting and mulch established beds with organic material each year to improve your soil.
- **Group plants according to their water needs.** Some plants require regular water to do their best. Many others will not need to be watered after the first few years in the garden, if properly selected and sited. Group plants with similar needs together so they all get the right amount of water.
- **Plan lawns appropriately.** To stay healthy and green, lawns need more water, more frequently than most other plants. Watering other planting areas along with your lawn can result in shallow roots, poor growth and disease. Lay out planting areas and irrigation systems to make it easy to water the lawn separately.
- **Select the right watering system.** Drip irrigation and soaker hoses are the best way to water most plantings (except lawns). Drip and soaker systems apply water directly to the soil with minimal evaporation or runoff. They also help prevent plant diseases and make watering gardens easier.

2. Make every drop count.

Watering deeply but less often encourages deep roots and prevents disease. Moistening the soil a little deeper than the roots grow draws them deeper – which is particularly important in the first one to three years after planting, while plants are becoming established. Let the top few inches of soil dry before watering again, so roots and soil life can breathe.

Much of the water applied to lawns and gardens never makes it to plant roots. Make the most of every drop by following these simple guidelines:

- Use drip irrigation, micro-sprays or soaker hoses on all plants except the lawn.
- Mulch to reduce evaporation from the soil surface.
- Minimize evaporation by watering early in the day and when the wind is calm.
- Choose sprinklers with spray patterns that match the shape of your lawn or garden.
- Use sprinklers that apply water slowly enough so soil can absorb it without runoff. If puddling occurs, run sprinklers for a short time, then turn them off and allow water to soak in before you resume watering.
- Use rotating or oscillating lawn sprinklers, not fixed sprays (except for properly designed, installed and maintained automatic irrigation systems).

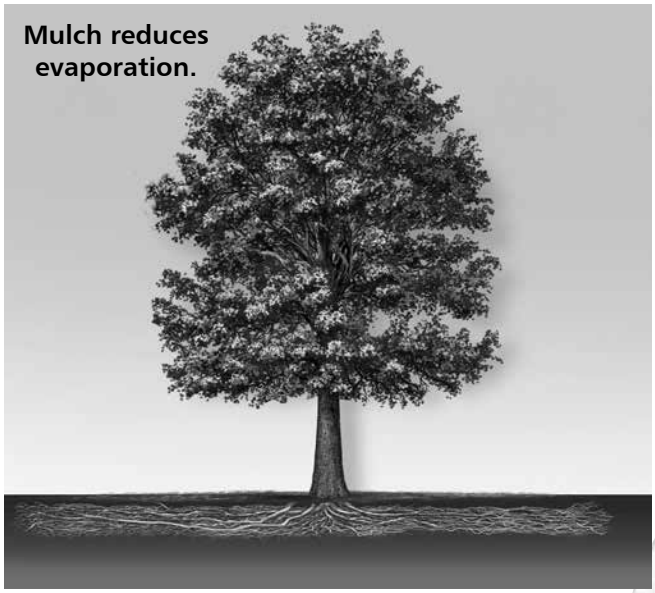


Illustration provided by Robert O'Brien and used with permission.

- Place sprinklers to avoid watering driveways, sidewalks or walls.
- Use timers to limit watering and to make early morning irrigation convenient.
- Adjust sprinklers to prevent fine misting that just blows away.
- Repair leaky faucets and hoses. Even small leaks waste lots of water.
- Consider removing unnecessary paved areas around your home or using pervious surfaces.
- Install a cistern. Captured water can then be slowly released into the ground or used for watering plants. Instead of using a cistern, direct your downspouts into your landscape, away from foundations or neighbors.
- Build a rain garden. Rain gardens are shallow, landscaped depressions that can hold and soak up runoff from roofs or driveways.

Drip and soak your way to a healthier landscape.

By applying water directly to the soil, drip irrigation and soaker hoses offer several advantages over sprinklers or hand watering. Here are a few reasons to use them.

- They conserve water by not spraying pavement, mulch, weeds and unplanted areas.
- They save time otherwise spent moving hoses and sprinklers, weeding and controlling disease.
- They help plants grow healthier and save you effort.
- They reduce plant diseases that spread by splashing soil and wet foliage.
- They apply water to large garden areas simply, efficiently and cost-effectively.
- They prevent erosion and runoff that waste water and pollute lakes, rivers and streams as well as other bodies of water.

Soaker? Drip? What's the difference?

Most gardeners are familiar with soaker hoses, which sweat water along their entire length. How does drip irrigation differ?

Drip systems apply water directly to the soil through tiny emitters or micro-sprays plugged into flexible

tubing laid on the ground or covered by mulch. Tubing can be placed around individual plants or spaced regularly to soak entire beds in densely planted areas. Drip systems allow more precise watering for plant needs and soil types, especially in large or sloped gardens where pressure changes make soaker hose output variable.

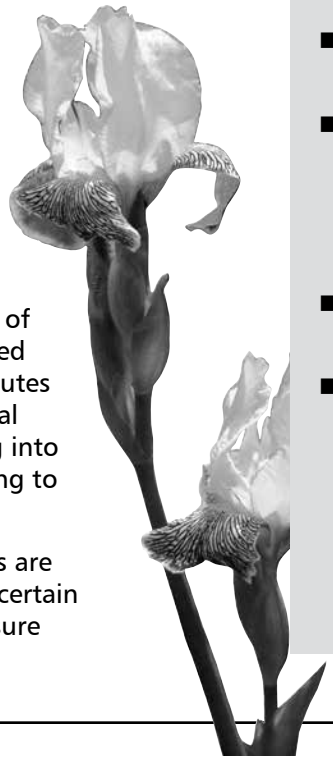
Drip tubing with emitters can be placed around individual shrubs and trees, in planting beds and containers. The number of emitters and flow rates should be selected according to your garden layout and soil type. Drip tape offers a simple and inexpensive way to thoroughly water closely planted beds or rows. Pre-installed outlets release water at regular intervals (usually 6 to 18 inches), selected depending on your soil and plant layout.

Micro-sprays are low-volume spray heads used to water closely planted ground covers and plants that prefer moist foliage.

Soaker hoses can be used to thoroughly water dense plantings or individual plants. You also can customize a watering system to your garden by attaching soaker hoses to solid hoses. This way, you avoid wasting water in areas that do not need it.

Dripping and Soaking Tips

- Keep your layout simple so it is easy to avoid damage, especially if the system is buried under mulch.
- Cover soaker hoses and drip systems with 2 inches or more of mulch (wood chips, bark or compost) to prevent evaporation and help spread the water flow. Quality drip systems are designed to prevent clogging.
- Soaker hoses will only save water if they are used for the right length of time. As a rule of thumb, a soaker hose may need to run for about 30 to 40 minutes per week to water most annual plantings. For best results, dig into the soil one hour after watering to check soil moisture depth.
- Drip systems and soaker hoses are designed to operate within a certain range of pressure. Use a pressure regulator to deliver water evenly and help prevent damage to the systems.
- Use a filter to prevent clogging from within your plumbing system.
- A backflow preventer keeps dirty water or fertilizers from entering drinking water. Contact your water provider for more information.
- Inform everyone who works in your garden about the system to prevent accidental damage.
- Use pressure-compensating drip emitters – not soaker hoses – for uniform watering of uneven areas, steep slopes or large gardens.



When it comes to your lawn and garden, don't waste water.

Use automatic sprinkler systems efficiently.

Automatically controlled irrigation systems can make efficient watering easier, yet they often waste large amounts of water due to improper scheduling or maintenance. Follow these smart-watering tips:

- Adjust your watering schedule to track weather conditions at least once or twice a month.
- Install a rain shut-off device to prevent watering when it rains.
- Inspect your system a few times during the watering season while it is running. Look for and repair leaking or broken sprinklers, and reposition those that spray unintended areas.
- Hire an irrigation professional to test and adjust your system annually.
- Use a WaterSense-labeled irrigation controller. These act like a thermostat for your sprinkler system telling it when to turn on and off, using local weather and landscape conditions to tailor watering schedules. Independently certified controllers can be found at **http://epa.gov/watersense/product_search.html?Category=5**.

3. When to water and how much?

Remember, the goal is to get water to the roots of your plants. Wetting the soil surface without penetrating the root zone does nothing for your plants. Overwatering literally drowns plants, rotting their roots and inhibiting nutrient absorption. So how much is right? The best way to find out if plants need water is to watch for signs that they are thirsty. You also can check how well your soil retains moisture by digging into the root zone with a garden trowel. If the soil feels moist, wait a day or two and check again. Use the chart below to determine when and how much to water your plants to keep them healthy.

How long should you water?

PLANTING BEDS: To determine the delivery rate of your watering system, perform this simple test. When it's time to water (check soil moisture with a trowel first), run sprinklers or drip/soaker lines for 15 minutes, then wait a few hours and dig into the soil to see how deep the water has gone. Repeat until soil is moist as far down as the roots grow. Check the soil every few weeks in summer to keep up with seasonal changes.

LAWNS: Most lawns need only 1 inch of water each week to stay green during summer. To find out how long your sprinklers take to supply this amount, place several short, straight-sided, empty containers (like tuna or cat food cans) on your lawn. Place some near the edges of the spray pattern and some near the center. Turn on the sprinkler(s) for 15 minutes, then measure the water depth in each can with a ruler and determine the average depth. Finally, use the chart below to estimate how long and how often to water your lawn each week to have 1 inch of water. Watering may need to be split into two or more applications to prevent run off.

How long should you water?

____	TO GET AN INCH: A SIMPLE WAY TO MEASURE				
Amount of watering in cans after 15 minutes equals ...	1/8"	1/4"	1/2"	3/4"	1"
How long you should water if you have:					
Clay soil (water once per week)	2 hrs.	1 hr.	30 min.	23 min.	15 min.
Loamy soil (water twice per week)	1 hr.	30 min.	15 min.	11 min.	8 min.
Sandy soil (water three times per week)	40 min.	20 min.	10 min.	8 min.	5 min.

Where, when and how much should you water?

WHERE / WHEN / HOW MUCH	ANNUALS	TREES, SHRUBS AND PERENNIALS	LAWNS
Water where the roots are.	Most roots are in the top 12 inches of soil, spreading just a short distance from the plant. (Recent transplants and seedlings have shallower roots.)	Root systems can go down a couple of feet and may extend two to five times the branch spread.	Typically 4 to 6 inches deep and only under areas covered by grass
Here are some signs it's time to water.	Soil is dry below surface.	Wilted leaves that do not perk up in the evening	Dull green color
	Evergreen leaves are dull or bronze. (Try not to let plants wilt. Most will be stunted or die if allowed to dry out.)	Yellowing deciduous leaves before autumn	Footprints show long after you walk across the lawn.
			It's difficult to push a trowel into the soil.
Here's when to water and how much.	Check soil often to make sure it stays moist 1 to 2 inches below the surface.	Water needs vary widely by plant and situation. Many may not need irrigation a few years after planting in proper conditions.	Apply no more than 1 inch of water each week during summer including rain.
		Refer to gardening books or ask nursery experts about water needs of plants.	Lawns that are allowed to turn brown recover better if they get a thorough soaking every month in summer.

Part Four:

Natural Pest, Weed and Disease Control

Basic Steps to Manage Your Garden Naturally

Insects, spiders and other crawling or flying creatures are a vital part of healthy gardens. Most perform important jobs like pollinating flowers, recycling nutrients and eating pests. In fact, less than 1 percent of garden insects actually damage plants. Unfortunately, the pesticides often used to control pests and weeds also are toxic to beneficial garden life – and may harm people, pets, aquatic life and other wildlife as well.

Follow these basic steps to natural pest, weed and disease control:

- **Create a healthy garden to stop pest problems before they start.** Healthy plants and soil not only resist pests and diseases, they also encourage beneficial garden life.
- **Identify pests before you spray, stomp or squash.** What you think is a pest may actually be a beneficial insect.
- **Give nature a chance to work.** Do not try to eliminate pests at the first sign of damage. Garden pests feed beneficial insect populations and allow them to grow.
- **Use the least toxic pest controls available.** You can often control pests by using traps or barriers, or by simply removing pests and infested plant parts. These methods do not harm beneficial garden life or the environment. If pesticides are the only way to control a problem, look for the least toxic ones and closely follow the application tips outlined later in this section (and follow label instructions exactly). Buy only the smallest amount available. (There is no way to recycle pesticides.)

Bad bugs – Aphids

Start with prevention.

- **Try integrated pest management.** This is an ecologically based approach to managing pests with an emphasis on natural and cultural control processes and methods including host plant resistance and biological control. Because the focus is on prevention, avoidance, monitoring and suppression of pests, chemical pesticides are used only where and when prevention measures fail to keep pests below damaging levels.
- **Build healthy soil to grow healthy plants.**

Good bug – Ladybird Beetle Larvae

When is it a pest?

- **Pest** refers to an insect, animal, plant or microorganism that causes problems in the garden.
- **Beneficials** are organisms in the air, on the ground or in the soil that do good things for your garden like pollinating flowers, feeding on insect pests or improving soil.
- **Some pests also are beneficials.** For example, yellow jackets are both predators of pests and painful to humans. When considering controls, weigh a creature's damage against damage to the entire community of garden life.

Amend and mulch entire growing beds with compost, and fertilize moderately with natural organic or slow-release fertilizers to grow vigorous, pest-resistant plants. Determine the nutrient requirements of plants. Do a soil test and add lime and/or fertilize according to recommendations.

- **Plant right.** Place each plant in the sun and soil conditions it prefers. Select varieties that are known to grow well in your garden conditions and resist common pest and disease problems.
- **Give your plants some space.** Good air circulation can prevent or reduce many disease and pest problems. Space plants so they have plenty of room to grow, and remove some when they become too crowded. Group plants in the landscape according to water needs and sunlight requirements.
- **Water wisely.** Overwatering and underwatering are two of the most common causes of plant problems. Observe plants and check soil as deep as roots grow before and after watering to make sure plants get the water they need, but not too much. You can check the soil with a trowel, shovel or a soil-coring tool. Water early in the day or use soaker hoses to prevent diseases caused by wet leaves.
- **Clean up.** Remove weeds, wood boards and other yard debris that can harbor pests and disease. Fallen leaves and fruit from plants like apple trees and roses with persistent diseases such as scab, rust and mildew should be put in curbside yard waste collection containers – not in home compost piles, ravines, streams or lakes.
- **Diversify and rotate annual crops.** Grow a variety of plants to prevent problems from spreading, as well as to attract pest-eating insects and birds. Do not plant the same type of annual vegetables in the same spot each year; crop rotation prevents pests and diseases from building up in the soil.

Reduce the need for pesticides.

Minimize the spraying of poisonous insecticides in your garden by letting certain types of plants and insect-eating animals control pests. Some plants, such as marigolds and onions, contain chemicals that repel pesky bugs. Toads, lady bugs, praying mantises and other insect-eating animals also can help control pest populations in your garden.

Try these plant combinations.

Experienced gardeners over the years have suggested plant combinations that work together in fending off insect pest problems. Actual research data on this phenomenon is not well established. These combinations should be taken as suggestions. Good companions are:

- beans with potatoes, cucumbers and carrots;
- beets with onions;
- cabbage with tomatoes, nasturtiums, thyme, mint, sage and rosemary;
- carrots with peas, leaf lettuce, thyme, leeks and chives;
- corn with soybeans, pole beans and vine-crop families;
- garlic around fruit trees and raspberry plants;
- leaf lettuce with radishes, carrots, chives and garlic;
- peas with turnips, carrots and chives;
- potatoes with beans and cabbage;
- tomatoes with dill, parsley and basil; and
- vine crops with radishes, oregano and nasturtiums.

Biological Control

Beneficial insects can be purchased and released to control many home garden pests. If prey or habitat is not suitable, the released beneficial insects may venture off your property in a short time.

The best approach is to encourage and conserve natural populations of beneficial insects. This can be done by avoiding or minimizing application of chemical insecticides and planting flowering plants that attract beneficial insects to the garden.

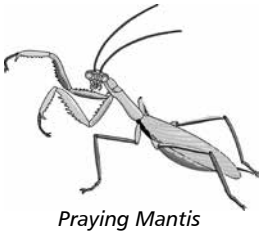
Beneficial insects fall into two groups – parasites and predators.

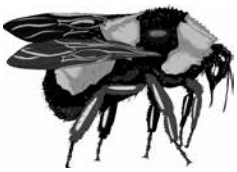
Parasites live on or in the bodies of insects. Predators capture and devour insects. A number of biological agents also are available for pest control (e.g., *Bacillus thuringiensis* (Bt), milky spores, growth regulators).

NOTE: Information adapted from "Integrated Pest Management (IPM)," Master Gardener Fact Sheet by Dr. Geoff Zhender, Clemson Extension IPM Specialist and the Seattle "Natural Pest, Weed and Disease Control" publication.

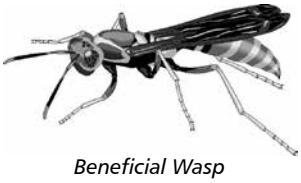
Plants and Beneficial Insects They Attract ...

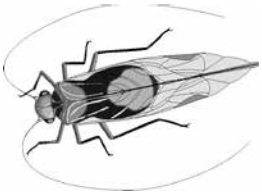
PLANT	BENEFICIAL INSECTS ATTRACTED	PEST(S) REPELLED
Anise *(Pimpinella anisum)*	Ladybugs, parasitic mini-wasps, tachinid flies	
Basket-of-Gold *(Aurinia saxatilis)*	Ladybugs, hoverflies	
Bee balm *(Monarda spp.)*	Bees, parasitic mini-wasps, beneficial flies	
Chives	———	Aphids
Coreopsis *(Coreopsis tinctoria)*	Spined soldier bugs, hoverflies, tachinid flies	
Cosmos *(Cosmos bipinnatus)*	Parasitic mini-wasps, hoverflies	Tachinid flies, bees
Dahlia	———	Nematodes
Dill *(Anethum graveolens)*	Lacewings, hoverflies, ladybugs, parasitic mini-wasps, tachinid flies	
Fennel *(Foeniculum vulgare)*	Lacewings, hoverflies, ladybugs, parasitic mini-wasps, tachinid flies	
Feverfew *(Tanacetum parthenium)*	Hoverflies	
Garlic	———	Aphids, borers, Japanese beetles, mites
Golden Marguerite *(Anthemis tinctoria)*	Lacewings, ladybugs, hoverflies	Parasitic mini-wasps, tachinid flies
Lovage *(Levisticum officinale)*	Beneficial wasps, ground beetles	
Marigolds	———	Nematodes, tomato hornworms, cucumber beetles
Painted daisy *(Chrysanthemum coccineum)*	Tachinid flies	Parasitic mini-wasps
Pennyroyal	———	Ants
Rosemary	———	Slugs
Salvia	———	Nematodes
Sweet alyssum *(Lobularia maritima)*	Hoverflies	
Tansy *(Tanacetum vulgare)*	Ladybugs, predatory wasps, many other beneficials	Ants, cucumber beetles, squash bugs, cutworms, Japanese beetles
Yarrow *(Achillea spp.)*	Lacewings, hoverflies, ladybugs, parasitic mini-wasps	
Zinnia *(Zinnia elegans)*	Ladybugs, parasitic mini-wasps, bees	


Praying Mantis


Bee

Ladybug


Beneficial Wasp


Lacewings

Meet the 'Beneficials' ...

See the illustration on the inside back cover.

Repellents

A variety of homemade and commercial preparations can be used to keep pests away from plants. Many gardeners claim repellents work, although some are not consistently effective in scientific trials.

A mixture of **raw eggs blended with water** produces a taste and odor that offend deer; some gardeners add garlic and hot pepper. Spraying this mix onto plant foliage can repel deer for several weeks or until it is washed off by rain or sprinklers.

Garlic oil and extracts are used to repel a variety of insect pests and also work as fungicides.

What can you do if a pest problem develops?

USE PHYSICAL CONTROLS FIRST. Many pests can be kept away from plants with barriers or traps or controlled by simply removing infested plant parts. These controls generally have no adverse impact on beneficial garden life, people or the environment.

REMOVAL: Pests and diseased plant parts can be picked, washed or vacuumed off plants to control infestations. In fact, pulling weeds is a natural pest control.

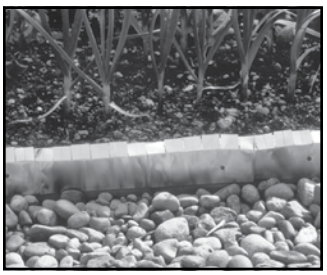
- **Handpicking** can be effective for large pests like cabbage loopers, tomato hornworms, slugs and snails. You can knock the pest off with a stick, then step on it.
- **Pruning out infestations** of tent caterpillars is effective on a small scale. Control leaf miners on beets or chard by picking infected leaves. Put infestations in curbside yard waste collection containers – not in home compost piles which do not get hot enough to destroy pests.
- **Washing aphids off plants** with a strong spray of water from a hose can reduce damage (pictured below left). Repeated washings may be required as this process does not kill the aphids.

TRAPS: It is possible to trap enough pests like moths and slugs to keep them under control. You also can use traps for monitoring pest numbers to determine when controls may be necessary.

See two simple and effective pest traps below.

- **Cardboard or burlap wrapped around apple tree trunks** in summer and fall will fool coddling moth larvae into thinking that they have found a safe place to spin their cocoons as they crawl down the tree to pupate. Traps can be peeled away periodically to remove cocoons.
- **Slug traps** can drown slugs in beer or in a mixture of yeast and water. An old pie pan filled with beer can quickly and easily drown many slugs.

BARRIERS: It is often practical to physically keep pests away from plants. Barriers range from 2-inch cardboard "collars" around plants for keeping cutworms away to 8-foot fences for excluding deer.



- **Floating row covers** are lightweight fabrics that let light, air and water reach plants while keeping pests away. They are useful for providing a barrier to pests in vegetables.

- **Mesh netting** keeps birds away from berries and small fruit trees.
- **A band of sticky material around tree trunks** stops ants from climbing trees and introducing disease-carrying aphids.

Use least toxic pesticides when physical controls don't work.

The following pesticides have a low toxicity or break down quickly into safe by-products when exposed to sunlight or the soil. They are the least likely to have adverse effects. Even these pesticides, however, can be toxic to beneficial garden life, people, pets and other animals – especially fish. They should be used carefully and kept out of streams and lakes.

Soaps, Oils and Minerals

- **Horticultural oils** smother mites, aphids and their eggs, scales, leaf miners, mealybugs and many other pests. They have little effect on most beneficial insects.
- **Horticultural soaps** dry out aphids, white flies, earwigs and other soft-bodied insects. They must be sprayed directly onto the pests to work, so repeated applications may be necessary. There also are soap-based fungicides and herbicides.
- **Sulfur** controls many fungal diseases such as scab, rust, leaf curl and powdery mildew without harming most animals and beneficials. For greater effectiveness, sulfur can be mixed with lime. Sulfur also is frequently combined with other materials to create more toxic fungicides.
- **Baking soda** (1 teaspoon) mixed with dish-washing liquid (a few drops) and water (1 quart) has been used by rose growers to prevent mildew. A commercial product also is available that contains potassium bicarbonate, which is similar to baking soda.
- **Iron phosphate slug baits** are less toxic than other slug baits and not as hazardous to dogs.

Botanicals

These plant-derived insecticides degrade quickly in the sun or soil. Most, however, are initially toxic to people, animals, fish and beneficial garden life. Use cautiously and follow label directions closely, just as when applying synthetic pesticides.

- **Neem oil** kills and disrupts feeding and mating of many insects including some beneficials. It also is an effective fungicide and the botanical least toxic to people, animals, birds and fish.
- **Pyrethrum, ryania and sabadilla** kill many tough pests, but also are toxic to beneficial insects, people, fish and other animals. These pesticides should only be used as a last resort.

Biocontrols

- ***Bacillus thuringiensis* (Bt)** is a common, commercially available bacterium that poisons caterpillar pests, including cutworms, armyworms, tent caterpillars, cabbage loopers and corn earworms. Bt is not toxic to people, animals, fish or insects – although it can kill caterpillars of non-pest butterflies and moths.
- **Predatory nematodes** kill a variety of pests, including cutworms, armyworms, root maggots, crane fly larvae, root weevil larvae and other soil-dwelling pests. Proper soil temperature and moisture are required for nematodes to be effective.
- ***Beauveria bassiana*** is a commercially available fungus that destroys an extensive range of pest insects.
- **Beneficial insects** like ladybugs and lacewings can be purchased and released. A healthy and diverse garden usually will have lots of them around already.
- **Compost teas** use compost organisms to help control leaf and root diseases. They are sometimes effective and they won't harm any beneficial organisms. Call Clemson Extension's Home and Garden Information Center at **1-888-656-9988** for more information.

Use synthetic pesticides only as a last resort.

When physical and least-toxic controls fail to manage a pest, other pesticides may be used as a final resort. But first, consider your pest problem. Is it the result of poor plant placement? Is it likely to recur after pesticide treatment? Keep in mind that scientists have found pesticides – including commonly used

insecticides – in local streams, some at high enough levels to harm fish and what they eat.

- **Don't use services that spray insecticides or herbicides on a pre-scheduled plan.** Preventive sprays can disrupt natural controls and may do more harm than good. Fungicides are an exception because they only work when applied prior to the appearance of the problem. Use the least toxic fungicides only on plants that have been infected in previous years.
- **Look for the least toxic pesticide.** Ask nursery staff for help identifying the least toxic pesticides for your pest problem. For publications on pesticide use and safety, visit **www.clemson.edu/extension/hgic**. Avoid products with warnings like "highly toxic," "causes permanent eye damage," or "may be fatal if swallowed." Choose "ready-to-use" products that are safer to use instead of more toxic concentrates that require mixing.
- **Don't use broad-spectrum insecticides** like diazinon, chlorpyrifos (Dursban), malathion and carbaryl. These are likely to kill more of the pests' natural enemies than the pests themselves. Pest populations may soar and become more of a problem than before they were sprayed.
- **Avoid "weed and feed" and other pesticides that are broadcast over the entire yard.** Instead, spot apply the least toxic product only where you have a pest or weed. In South Carolina, the time to "weed" is fall and early winter. It is not, however, the time to "feed" dormant grass.
- **Buy only as much as you need.** Unused pesticides are dangerous to store and expensive for individuals and local governments to dispose of. There is no way to recycle pesticides in South Carolina.
- **Carefully follow label directions.** Only use pesticides on the plants and pests listed on the label and apply exactly according to label directions. Be sure to wear specified protective clothing and equipment. Keep children and pets off application areas for the time specified on the label.
- **Apply only when and where pests are present.** Timing is critical with all pest controls. Most pesticides should not be used as a preventive measure except for fungicidal tree sprays.
- **Dispose of empty pesticide containers properly.** Empty containers should be disposed of in your garbage. Dispose of unused pesticides at hazardous household product (HHP) collection sites where available. (**NOTE:** Charleston County **(843) 720-7111**, Georgetown County **(843) 545-3452**, Horry County **(843) 347-1651** and York County **(803) 628-3195** have permanent disposal options available.)

What about weeds?

A "weed" is simply a plant in the wrong place. Some weeds compete with desirable plants, but many are merely aesthetic concerns. For instance, white clover is often considered a weed in lawns, yet it stays green when dry conditions turn lawns brown and its roots support bacteria that transform nitrogen from the air into plant fertilizer. So clover feeds your lawn every time you mow.

- **Accept a few weeds in your lawn.** Target the problem weeds and leave the others. Many people who see a lawn with 10-20 percent weed cover consider it healthy and good looking.
- **Prevention: Don't give weeds a chance.** Weeds thrive in bare soil and neglected garden areas. Plant spreading ground cover to outcompete weeds or smother them with weed barriers and lots of mulch.
- **Physical control: Be a control freak with problem weeds.** A single weed flower can produce thousands of seeds. To prevent future infestations, remove weeds before they go to seed. Cultivating with a hoe works well on young or shallow-rooted weeds in garden beds or paths. Long-handled pincer-type weed pullers work

Spread mulch to prevent weeds.

great for weeds with taproots like dandelion and thistle, especially in lawns when soil is moist.

- **Least toxic controls: Corn, soap or vinegar?** Herbicides with low toxicity to beneficial garden life, people and wildlife include corn gluten (a milling by-product used as animal feed), herbicidal soaps and vinegar (acetic acid). Corn gluten prevents the growth of weed seedlings, but actually fertilizes established plants. It is sold under several brand names. Corn gluten's effect is short-lived, so applications must be timed to coincide with seed germination. Herbicidal soaps and vinegar both damage leaf cells and dry out plants. Tough weeds resist these herbicides or resprout from roots. Some concentrated vinegar products can cause permanent damage if accidentally splashed into the eyes. Ready-to-use dilutions are safer.

- **As the last resort, spot apply synthetic herbicides.** When extreme weed problems call for treatment with synthetic chemical herbicides, carefully apply them (only as directed on the label) directly onto weed leaves. Do not use "weed and feed" or pre-emergent products, because when it is time to weed, it is not time to feed. Therefore, a product is being used unnecessarily which spreads toxic herbicides all over lawns or gardens and is likely to run off into streams. If you are applying an herbicide on a regular basis, there is probably a landscape design or soil problem that needs to be addressed.

Natural Pest Control Resources

Call the Clemson Extension's Home and Garden Information Center at **1-888-656-9988** to ask a question or to request pest control information.

Community groups, garden clubs and landscape professionals also can request a presentation to learn more about natural pest management methods.

You also can visit **www.clemson.edu/extension/hgic** to see pest management publications.

Books for Gardeners ...

- ***Month by Month, Gardening in the Carolinas***, by Robert Polomski, offers expert advice on what should be done in the garden and the correct time to do it.

- ***Southern Living Garden Problem Solver***, Steve Bender, editor, has photos and descriptions of many common insect and disease problems in the Southeast.

Clemson Extension Resources and Services

- **Attend Master Gardener Clinics.** Master Gardener volunteers are available to answer questions and diagnose problems over the phone or at clinics held regularly throughout South

A home gardener is shown hand weeding.

A home gardener uses a weed puller.

Spot apply the least toxic herbicide.

Carolina. For phone help and clinic locations, call your Clemson Extension office, 8 a.m. to 4:30 p.m.

- **View Clemson Extension publications** on horticulture and pest management online at **www.clemson.edu/extension/hgic**.
- **Watch "Making it Grow"** on South Carolina ETV, a common sense approach to gardening.
- **Read related publications.** For a small charge, many bulletins on growing plants and managing pests may be ordered from your Clemson Extension office. Landscape professionals and home owners can purchase the **"Pest Management Handbook"** from a Clemson Extension office.
- **Listen to "Your Day"** on ETV Radio for local topics including gardening.
- Learn about actions to **protect waterways and prevent pollution through Carolina Clear**. Visit **www.clemson.edu/public/carolinaclear**.
- Learn simple but effective principles and actions that can **create a low-maintenance and low-environmental impact yard with Carolina Yards**. Visit **www.clemson.edu/extension/natural_resources/water/carolina_yards/index.html**.

Pesticide Disposal Emergencies

- **Poison Control** – In case of pesticide poisoning, call **911**.
- **Hazardous Household Products (HHP)** – For more information about properly managing HHP, visit **www.scdhec.gov/environment/lwm/recycle/pubs/hhp.pdf**. For HHP recycling or collection locations, call the S.C. Department of Health and Environmental Control's Office of Solid Waste Reduction and Recycling at **1-800-768-7348** or Clemson Extension's Home and Garden Information Center at **1-888-656-9988**.

Photograph by Joanne Jewell and Carl Woestwin

Part Five:

The Right Plants

Getting to Know Scientific Names

In this handbook, as well as in a number of gardening magazines and plant catalogs, you will find a botanical or scientific name associated with each plant. Although the scientific name may appear intimidating, it establishes the correct identity of the plant. Here are three important points to keep in mind.

- A plant may have several common names that may differ from one region of our state to another.
- Sometimes, two unrelated plants may share the same common name.
- Fortunately, a plant only can have one scientific or "given" name.

The scientific name has two words, almost like our first and last names. Our last name identifies us generically as being a member of a particular group, such as Smith, Jones or Sabal. In plant talk, it is called the genus. Our first name specifically identifies us, such as John, Mary or palmetto. This is known as the species.

When naming plants, we put the last name or genus first and the specific or species name last. For example, it would be Smith, John and *Sabal palmetto* whose common name is cabbage palmetto, the state tree of South Carolina. The genus is always capitalized and the species name is written in lower case. Also, the scientific name is either italicized or underlined.

Plants may have a third name – the cultivar – a shortened word for "cultivated variety." When a plant is discovered to have a unique characteristic that differs from the species, such as different-colored flowers, shorter stature or colorful leaves, it is called a cultivar. The cultivar name is capitalized and is enclosed by single quotation marks. Sometimes the cultivar may be abbreviated to cv. and written this way: *Camellia japonica* cv. 'Dr. Tinsley' (Dr. Tinsley Japanese camellia).

Sometimes, the plant may have a third and fourth name, especially when several distinct forms occur. You will see words like varieties (var.), subspecies (subsp.) or forms (f.) written after the species.

In some cases the scientific name may not have a species, such as when a cultivar is a hybrid of two or more species. In that case, the genus name will be followed by the cultivar.

Occasionally, you will find a trademark associated with a plant name. This marketing name is not a part of the scientific name; however, it can be confused with the cultivar name, especially when the cultivar is a nonsensical word in contrast to the more descriptive and appealing trademark name.

Begonia tuberhybridacultorum

Stock Photography

For example, the scientific name of 'QVTIA' live oak is *Quercus virginiana* 'QVTIA.' Yes, believe it or not, the official cultivar name is 'QVTIA,' but its marketing name is Highrise.

Scientific names give clues.

Although scientific names may be difficult to pronounce, they convey valuable and interesting information. The species names may give you a clue as to the geographic origin of the plant, such as live oak (*Quercus virginiana*), American elm (*Ulmus Americana*), Japanese andromeda (*Pieris japonica*), and Carolina buckthorn (*Rhamnus caroliniana*). Be careful because these species names can be unreliable. For example, eastern redbud (*Cercis canadensis*) appears to be native to Canada, but it will not survive north of New Jersey.

Some names honor a contribution.

Sometimes a scientific name honors the contributions of early botanists, plant explorers or famous people. For example black-eyed Susan (*Rudbeckia hirta*) is named for Olaf Rudbeck, the mentor of Carolus Linnaeus, the Swedish "father of modern botany." The magnolia was named after Pierre Magnol, a professor of botany in France.

Hints about Shape, Size, Color and Fragrance

Sometimes the species name offers hints about shapes and sizes such as minor or small (periwinkle – *Vinca minor*), ovata-oval or egg-shaped (mountain camellia – *Stewartia ovata*) and macro or large (Dutchman's pipe – *Aristolochia macrophylla*).

The growth form may be erectus or upright (stinking Benjamin – *Trillium erectum*), scandens or climbing (climbing bleeding heart – *Dicentra scandens*) and repens or creeping (trailing arbutus – *Epigaea repens*).

The color may be alba or white (white oak – *Quercus alba*) nigra or black (river birch – *Betula nigra*), roseus or rose-colored (rose coreopsis – *Coreopsis rosea*), fulvus or orange-gray-yellow (orange daylily – *Hemerocallis fulva*).

A species may offer clues as to fragrance (e.g., winter honeysuckle – *Lonicera fragrantissima,* sweet pea – *Lathyrus odoratus,* bearsfoot hellebore – *Helleborus foetidus*, which sounds rather foul-smelling).

Is it evergreen or deciduous?

You can tell from its species name that possumhaw holly (*Ilex decidua*) is deciduous or loses its leaves in the winter. Yellow jessamine (*Gelsemium sempervirens*), the state flower of South Carolina, is evergreen and its species name – *sempervirens* – means "always green."

Do not worry about being able to pronounce these scientific names properly. Chances are, the person you are speaking to may not feel very comfortable with the Latin name either. As long as both of you use the same "plant language" with scientific names, you should be able to select the right plants for your landscape.

Zinnia elegans Stock Photography

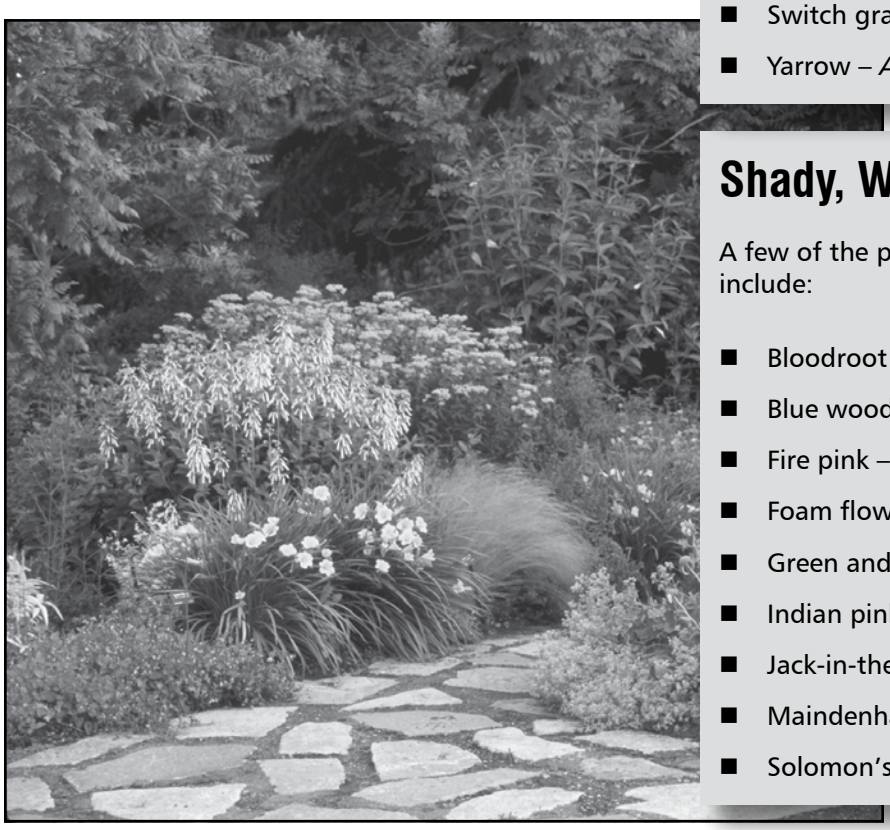
Tagetes patula Stock Photography

How to Select the Right Plants for a Beautiful, Trouble-free Garden

When you grow plants in the right conditions, they thrive with minimal care. By choosing plants well adapted to each garden situation, you save time and money, reduce maintenance, help prevent pests and diseases and leave more clean water for the wildlife. Plan now and enjoy the benefits for years to come.

This handbook takes you through the following simple steps for choosing plants that will flourish in your garden:

- **STEP 1: Get to know your site.** Learn about the conditions in each part of your garden. Once you know your soils and microclimates – the areas in your landscape with unique climatic characteristics – you can choose plants that will thrive in each area.
- **STEP 2: Dream a garden.** Decide how you want to use your landscape and consider all the ways plants can help you create play areas, colorful flower displays, privacy or shade, wildlife habitat, food and more.
- **STEP 3: Create a plan to fit your site.** Identify plants that will thrive with little maintenance in each situation as well as providing the colors, scents, fruits or other qualities you desire.
- **STEP 4: Give plants a good start.** Prepare your soil with compost, plant properly, mulch and follow healthy watering practices. For more information, see the "Healthy soil is the key" and "Smart Watering" sections in this handbook.



Dry, Sunny Gardens ...

A few of the plants that thrive in these conditions include:

- Scarlet beebalm – *Monarda didyma*;
- Black-eyed Susan – *Rudbeckia hirta*;
- Butterflyweed – *Asclepias tuberosa*;
- Joe-pye weed – *Eupatorium fistulosum*;
- Purple coneflower – *Echinacea purpurea*;
- Stokes aster – *Stokesia laevis*;
- St. John's Wort – *Hypericum frondosum*;
- Switch grass – *Panicum virgatum*; and
- Yarrow – *Achillea millefolium*.

Shady, Woodland Gardens ...

A few of the plants that thrive in these conditions include:

- Bloodroot – *Sanguinaria canadensis*;
- Blue woodland phlox – *Phlox divaricata*;
- Fire pink – *Silene virginica*;
- Foam flower – *Tiarella cordifolia*;
- Green and gold – *Chrysogonum virginianum*;
- Indian pink – *Spigelia marilandica*;
- Jack-in-the-Pulpit – *Arisaema triplyllum*;
- Maindenhair fern – *Adiantum pedatum*; and
- Solomon's Seal – *Polygonatum biflorum*.

STEP 1: Get to know your site.

First, make a simple map of your garden conditions. All it takes is a tape measure, shovel, graph paper and colored pencils. (Observing your existing landscape over the seasons can really pay off here and in "STEP 2: Dream a garden.") After carefully measuring, create a drawing of your property to scale, showing all buildings, pavement, rockeries, trees, planting beds and other landscape features. Dig small holes about a foot deep in several spots around the yard to check soil type and identify problem situations such as compaction or poor drainage. Next, use colored pencils to outline the following microclimates and landscape conditions:

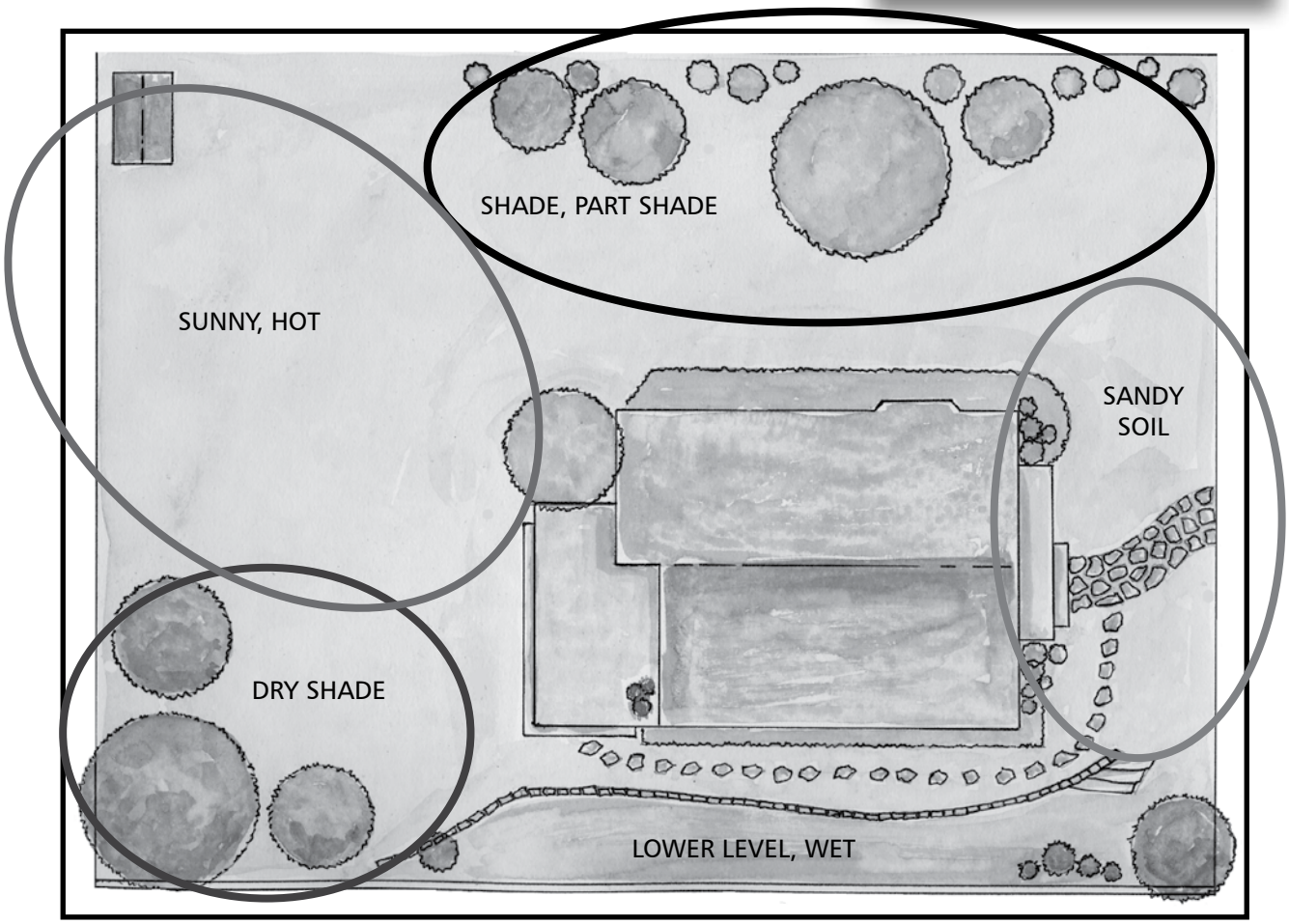
- sunny, shady and partly sunny areas;
- "hot spots" on the south or west sides of walls or fences or next to pavement;
- windy or exposed areas;
- areas with rocky or compacted soil that needs improvement;
- wet or poorly drained areas, runoff or draining downspouts;
- slopes that may erode or are difficult to mow;
- places that are hard to access for maintenance; and
- dry spots under roof eaves or evergreens.

Lawns and vegetables are picky.

Healthy lawns and vegetable gardens need well-drained soil at least 6 inches deep and require several hours of direct sunlight per day.

Many shrubs, trees and perennials will grow well in shady or wet spots, but lawns will have constant problems in these conditions.

Few vegetables will produce well in shade or in poorly drained or shallow soil.



STEP 2: Dream a garden.

Before choosing plants that will do well in your garden, think about what plants can do for you. Strategic landscaping can define outdoor spaces, attract wildlife and provide privacy, play areas, food, colorful flowers and foliage, fragrant herbs and much more. Best of all, you can accomplish all of this with low-maintenance, water-wise plants.

Decide how you want to use your garden and how much time you want to spend working in it. Look around your neighborhood for ideas and in gardening books for ideas.

Consider the following options when planning your landscape:

- vegetable and herb gardens;
- flowers and colorful foliage;
- fruit trees;
- food, water and shelter for birds, butterflies and other wildlife;
- living screens for privacy;
- decks or paved areas for outdoor living;
- low-maintenance areas;
- wood-chip areas or lawn for play;
- views you want to accentuate or block;
- pathways necessary for home and garden maintenance;
- specific plants you want to keep, move or remove;
- garden storage and composting areas;
- potting and work areas;
- places for creating and displaying art; and
- other needs.

STEP 3: Create a plan to fit your site.

Once you know your garden conditions and what you want your landscaping to accomplish, you can lay out your garden. Pair your site map from STEP 1 with your list of objectives from STEP 2 to define areas of use and select plants for each location. For example, put your lawn and vegetable garden in sunny areas with good drainage. The bird and wildlife viewing sanctuary you've always wanted as well as the compost pile can go in the shady area. Use sheets of tracing paper laid over your site map to experiment with varied layouts, and match plants with the conditions that best suit them.

Choose the right plants for each spot.

- **Choose plants that thrive without irrigation.** Many plants grow beautifully with just the water

Trees: Environmental Heroes

Did you know that trees play a crucial role in our gardens and environment? They shelter and feed wildlife, cleanse the air, reduce storm runoff and prevent soil erosion.

Deciduous trees planted on the south and west sides of a building provide summer shade, while letting sun through naked branches in the winter. Trees also can help block winter winds.

When planting trees on a suburban or city-sized lot, think small. Trees can grow quickly and shade out lawns or sun-loving plants. Falling limbs from large trees can damage structures and power lines.

Acer palmatum "Oskazuki"

Photograph courtesy of Great Plant Picks

provided by nature once they are established in your garden. Plant moisture-loving varieties where soil stays wet. Drought-tolerant plants perform best where soil is dry in the summer.

- **Select pest- and disease-resistant varieties.** Whether you grow roses or rhododendrons, apples or tomatoes, you will find that certain varieties resist common pests and diseases better than others. Look for these in nurseries and seed catalogs. Read the labels on the plant containers.
- **Diversify your plant investments.** Landscapes characterized by a rich array of plants resist the spread of pests and diseases better than gardens with little variety. Diverse plantings attract birds and insects that eat pests – and are more attractive to people, too.
- **Why not go native?** Indigenous plants have adapted to the local climate and pests. Many natives are beautiful and easy to grow. The needs of natives vary and, for best results, they must be grown in the right conditions – just like any other plant.
- **Also refer to "Landscape Design for Energy Efficiency"** by Mary Taylor Haque, Lolly Tai and Don Ham.

Plan for easy maintenance and efficient irrigation.

At every stage of laying out your garden, consider how to water wisely and make upkeep easy.

- **Plant practical lawns.** Include only as much lawn as you need and want to maintain. Remember that lawns need regular watering in summer to stay green and need weekly mowing during several months of the year. Avoid planting lawns on slopes, narrow strips or irregular shapes that are hard to mow or irrigate.
- **Create low-maintenance areas.** Plant slopes, areas along fences and other hard-to-access sites with quick-growing, groundcover plants that crowd out weeds and require little watering.
- **Group plants by their water needs.** This way, they can be watered by the same sprinkler or irrigation zone with each group receiving just the right amount of moisture. Lawns should be irrigated separately from other plants with different water needs.
- **Create irrigation zones for each exposure.** Plants in full sun usually use more water than those grown in the shade and should be watered using different zones if you have an automatic irrigation system.
- **Drip and soak for savings.** Drip irrigation and soaker hoses provide the best way to water most plants other than lawns. They apply water directly to the soil, without wasting it on pavement or allowing water to evaporate as it sprays into the air.

STEP 4: Give plants a good start.

Any plant you choose will grow best with good soil preparation, proper planting and care. The following simple practices will help prevent many problems.

Build healthy soil.

- Loosen soil at least 10 to 12 inches deep throughout planting beds and 6 to 8 inches deep in lawns. Use a shovel or digging fork or a rototiller for large areas. Try a pick or mattock to break through compacted layers.
- Thoroughly mix compost into loosened soil throughout the planting bed when planting a new or remodeled garden area. When planting individual plants in the middle of a lawn or into an established planting bed, loosen the soil in an area at least 3 to 4 feet in diameter – larger

Create a garden for all seasons.

Landscape for year-round interest.

- **Look for winter standouts**, including plants that feature varied leaf color or texture as well as colorful winter bark or berries.
- **Include evergreens.** Use both coniferous and broadleaf evergreen plants to define spaces while keeping your garden green throughout the year.
- **Provide winter structure.** Woody trees and shrubs as well as arbors, trellises and garden art provide visual interest during the dormant season.

for root balls measuring over a foot wide – but do not add soil amendments since this may prevent the plant's roots from spreading beyond the planting hole.

Plant right.

- Dig a hole large enough to spread the plant's roots.
- Form a firm mound at the bottom of the planting hole. Make it high enough so that the top of the root ball is at the soil surface as it was in the pot or at the nursery.
- Loosen and spread the roots. Untangle circling or matted roots and spread them out around the plant using a hose to gently spray soil off the outside of the root ball if needed.
- Fill in with the soil removed to make the planting hole. Firm soil with your hands and water thoroughly. Check the level of the plant after watering has settled the soil.

Viburnum tinus – "Spring Bouquet"

Photograph courtesy of Great Plant Picks

Mulch and water wisely.

- Spread mulch in a circle extending a little further out than the plant's branches. Mulch keeps roots moist and makes soils loose and absorbent. Keep mulch a few inches away from the plant's trunk or stems.
- Water as needed until plants are established. Even the most drought-tolerant plants need irrigation their first two or three summers. Once established, they can get by with little or no water in addition to what nature provides.

Rhododendron "Hinodegiri"

Part Six:

Natural Lawn Care

Try going natural.

- **Healthy lawns are easy on the environment.** Going natural may mean you need to accept a lighter green color, a few weeds and mowing a little higher than you're used to doing. But you'll have a healthy, good-looking lawn that's easier on the environment.
- **Why make a change?** Your lawn can be a great place to hang out, but depending on how you care for it, your lawn also can be part of big environmental problems.
- **Lawn and garden watering make up more than 40 percent of our summer water use.** That's when supplies are lowest and when wildlife and people need it most. Much of this water is wasted through over-watering – a practice that invites lawn disease.
- **Rainwater can wash pesticides from our lawns into streams or lakes.** Rain also can wash fertilizers from lawns into local waters. The fertilizers feed algae that smother fish and other water dwellers.
- **Pesticides may not be so great for you and your kids either.** Studies have found an increased cancer risk related to pesticide use. And safe disposal of pesticides costs you big bucks.

Stock Photography

Grasscycling

Grasscycling is leaving the clippings on the lawn. It's that simple. This saves you time and money and helps prevent the growing problem of overloaded compost facilities.

It's good for your lawn and the environment, too. Grasscycling provides at least a quarter of your lawn's fertilizer needs. If you use less fertilizer, there's less chance of it washing into our streams.

Natural lawn care works.

Fortunately, the natural lawn care practices outlined in this section make it easy to reduce the use of hazardous products while saving time, water, money and helping to preserve our environment.

These practices will result in a healthier lawn as well as being healthier for you, your children and pets.

Six Steps to Natural Lawn Care

Healthy lawns grow on healthy soil. Using proper soil preparation and lawn-maintenance practices will help build healthy soil and vigorous, deep-rooted lawns. These lawns are more resistant to disease, tolerate some insect and drought damage and will outgrow many weeds. The practices recommended in this section can help make lawns healthier for our families, protect beneficial soil organisms and protect our environment, too.

STEP 1: Grasscycle – Mow high, mow often and leave the clippings.

- **Set mowing height** to remove only one-third of the grass length at each mowing. Try to mow weekly in spring. Cutting too much at once stresses the grass. Mowing height varies by type of grass, but mowing high helps develop deeper roots and crowds out weeds.
- **Leave the clippings on the lawn.** Grasscycling provides free fertilizer (at least one-fourth of your lawn's needs), helps lawns grow greener and denser, and doesn't build up thatch.
- **You can grasscycle with your existing mower.** For best results, keep the blade sharp, mow when the grass is dry and mow a little more often in the spring. Clippings left scattered on the surface will break down quickly. If there are clumps, mow again to break them up. Push mowers work great for grasscycling.

Mulching Mowers ...

For clean mowing that leaves no visible clippings, consider buying a mulching mower. This mower will chop clippings finely and blow them down into the lawn so they disappear and won't be tracked into your house.

Check the spring issues of "Consumer Reports" for current ratings of mulching mowers. The rechargeable electric mulching mowers are quiet, clean and grasscycle very well.

STEP 2: Fertilize moderately in late spring and before the end of August with a 'natural organic' or 'slow release' fertilizer.

Before applying any fertilizer to your lawn, have your soil tested.

- **Slow-release fertilizers feed nutrients to the lawn slowly** and less is wasted through leaching or runoff to streams. "Quick-release" fertilizers are 100 percent water soluble and wash into streams easily. Instead, look for the words "natural organic" or "slow-release" on the bag.
- **Slow-release fertilizers will have a least one-half of its nitrogen in a water-insoluble form.** This is listed on the label as water-insoluble nitrogen (WIN) or sulfur-coated urea on the label.
- **Healthy lawns are a medium green color**, depending on the variety of grass. The darkest green turf, which many people strive for, is not in fact the healthiest turf. Over-fertilized lawns are more prone to disease, thatch buildup and drought damage.
- **With slow-release or organics fertilizers, you can fertilize just twice a year**, in mid- to late May and again in late August. If you choose to fertilize only once, the fall application is the most important.
- **Remember, grasscycling returns valuable nutrients** to the soil every time you mow.

Fertilizer: How much is enough?

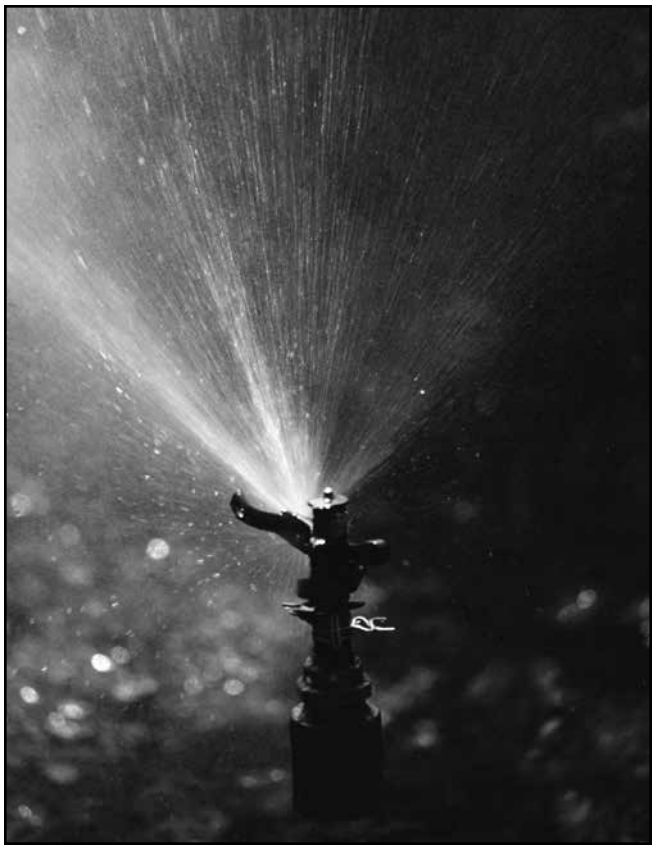
Clemson Extension recommends that home lawns receive 1 to 4 pounds (depending on the type of grass) of nitrogen (in a balanced fertilizer) per 1,000 square feet of lawn each year. Grasscycling can supply at least one-quarter of that.

Split the rest into two or three applications before the end of August. Avoid fertilizing in the early spring because it makes lawns grow too fast. Unless your lawn needs help recovering from disease or insect damage, wait until June to fertilize.

STEP 3: Water deeply to moisten the root zone, but infrequently.

- **Grasses do better when the whole root zone is wet and then partially dries out between waterings.** Avoid frequent shallow watering that causes shallow rooting. Too much watering can promote lawn disease, leach nutrients from the soil and waste water.
- **Aerate the lawn if water won't penetrate because of soil compaction or thatch buildup.** Dethatching also will help if there is heavy thatch buildup (more than a half inch).
- **Water about 1 inch per week during warm seasons and let the weather be your guide.** Water slowly, or start and stop, so the water penetrates rather than puddling or running off. Sandy soils will need lighter, more frequent watering because they can't hold much water. Water early (4 a.m. to 10 a.m.), not in the heat of the day.

Newly planted lawns may need daily watering if planted in the late spring or summer.



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STEP 4: Improve poor lawns with aeration and overseeding or consider fixing the soil and replanting.

- **Aerate compacted soil in the spring or fall to improve root development.** Use a rented power aerator for best results or hire a professional. (For small areas you can purchase a sod-coring tool). The soil should be moist. Make two or more passes to get better results. Rake or mow to break up the cores. The soil left will help to decompose excess thatch layers in the lawn. If your soil is deeply compacted (more than 2 inches – dig a hole to find out), find a landscape professional who has equipment that penetrates 6 to 8 inches to aerate for you.
- **Overseed thin areas to thicken the lawn and help crowd out weeds.** Overseeding with rye grass should be done when the days are warm enough for the seed to grow and the nights are cool enough to reduce the incidence of disease. Thirty days before the first frost, when highs are near 70°F and lows are above 50°F, is a good time to overseed. This usually corresponds to mid-September in the Upstate and late September in the Midlands and Coastal regions (from Clemson Extension's Home and Garden Information Center fact sheet #1206, available at **www.clemson.edu/extension/hgic**). Overseeding the right way can be accomplished with special equipment. Just casting seed onto the existing lawn will not give you the quality that you expect.

STEP 5: Think twice before using 'weed and feed' or other pesticides.

- **These products may damage soil and lawn health and pollute our waterways.** Some studies also suggest that using pesticides may harm our health.
- **Crowd out weeds and reduce pest damage by promoting a healthy, vigorous lawn through proper fertilization, irrigation and mowing.** Improve thin areas with aeration and overseeding. A healthy turf will need far fewer pesticides.
- **Accept a few "weeds" in your lawn.** Some, like clover, may look fine. Target the problem weeds, but leave the others.

- **Remove problem weeds by hand in the spring and fall.** Don't cover your entire lawn with weed and feed just to kill a few dandelions. Pincer-type, long-handled weed pullers are available at many garden stores. They work well in moist soil with no stooping. Pull dandelions when they're young. For best results, get as much of the root as possible.
- **Spot-spray problem weeds with the proper herbicide at the right time of year.** Identify the weed to make sure you are using the correct product.
- **Read the label carefully before using any pesticide.** Be sure to follow all label warnings, wear proper protective clothing and keep children and pets off the lawn for at least as long as the label specifies. Only buy as much as you need and completely use the contents before disposing of the container.

STEP 6: Consider alternatives to lawns for steep slopes, shady areas and near streams and lakes.

- **Leave a buffer of natural vegetation along streams and lakes to filter pollutants and protect fish and wildlife.** These buffers should include shrubs and trees to shade the stream and ground covers of native plants or low-maintenance grasses that are left unmowed and wild. Avoid using pesticides or soluble fertilizers near streams, ditches, wetlands and shorelines.
- **Grass grows best on well-drained soil in full sun or partial shade.** Steep slopes are hard to mow and water. Call your Clemson Extension office for information on alternative plants or grasses that do well in shady, steep or wet sites.

Poor Soil: What to do?

If your soil is very poor and compacted, it may be best to improve the soil and replant.

- **Till up old lawn.** If it is very weedy, remove the sod with a rented sod stripper or spray glyphosate (Roundup) on it to kill weeds.
- **Get a soil test** to find what's missing and spread the amendments (e.g., lime) suggested in the test results.
- **Spread 2 inches of quality compost and till it in to a depth of 6 to 8 inches.** Sandy or gravelly soils may need other amendments, too. Consult a certified landscaper or your local Clemson Extension office for help with these soils.
- **Rake the soil level**, roll with a landscape roller, water, allow to settle for a day and rake again.
- **Seed with an appropriate grass mix and water daily** if the weather is hot and dry until the lawn is well established.

Stock Photography

The Right Plants

Begonia tuberhybridacultorum

Zinnia elegans

Rhododendron "Hinodegiri"

**Acer palmatum "Oskazuki"*

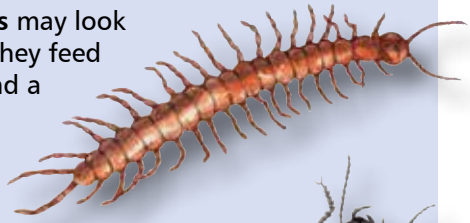
**Viburnum tinus*

Tagetes patula

Meet the 'Beneficials' ...

Spraying any pesticide may kill more beneficials than pests. Think twice before you spray.

- **Centipedes** may look scary, but they feed on slugs and a variety of small insect pests.



- **Ground beetles** eat slug eggs and babies plus other soil-dwelling pests.

- **Hornets and yellow jackets** are effective predators of many garden pests. Controls, however, may be necessary if they pose a threat to people or pets.

- **Lacewings** and their alligator-like larvae eat aphids, scales, mites, caterpillars and other pests.

- **Ladybird beetle larvae and adults** feed on soft-bodied insects such as aphids, mealybugs, scale insects and spider mites as well as insect eggs.

**These photographs are provided courtesy of Great Plant Picks.*

CLEMSON EXTENSION

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

About the S.C. Smart Gardener Program ...

The S.C. Smart Gardener Program was developed by a unique partnership to encourage waste reduction and to protect land and water resources in South Carolina. This partnership includes the S.C. Department of Health and Environmental Control, the Clemson Extension Service and the S.C. Department of Natural Resources.

For more information, visit **www.scdhec.gov/compost** or call **1-800-768-7348**.

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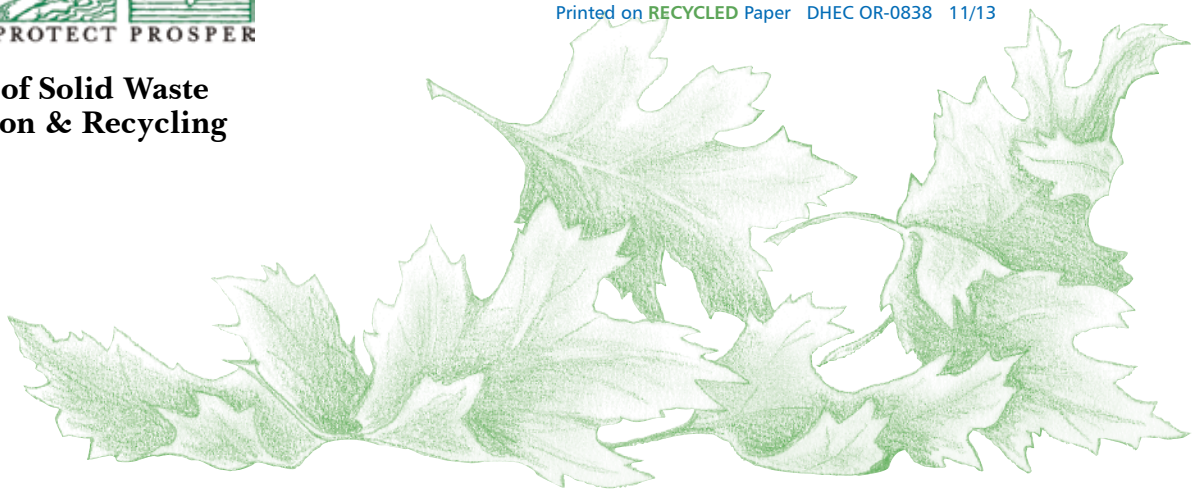
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